

SOME BASIC CONCEPT OF CHEMISTRY (MOLE CONCEPT)

1. 0°C and 760 mm = NTP

$$n = \frac{22.4}{22400} = \frac{224}{224000} = 10^{-3} \text{ mol}$$

$$\text{no. of molecules} = 10^{-3} N_A$$



$$100 \text{ mL} \longrightarrow 0 \quad 0$$

$$(100 - 100) \longrightarrow - \frac{3 \times 100}{2} = 150 \text{ mL}$$

$$V_i = 100 \text{ mL}$$

$$V_f = 150 \text{ mL}$$

$$(V_f - V_i) = 50 \text{ mL}$$

3. mass of 1 molecule of $\text{H}_2\text{O} = 18 \text{ amu}$

$$= 18 \times 1.67 \times 10^{-24} \text{ g}$$

$$= 30 \times 10^{-24} \text{ g}$$

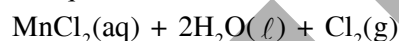
$$= 3 \times 10^{-26} \text{ kg}$$

4. No. of atoms of gold = no. of moles $\times N_A$

$$= \frac{19.7 \times 10^3}{197} \times N_A$$

$$= 10^2 N_A = 6.023 \times 10^{25} \text{ atoms}$$

5. $\text{MnO}_2(\text{s}) + 4\text{HCl}(\text{aq}) \longrightarrow$



$$1 \text{ mol MnO}_2 \text{ requires} = 4 \text{ mol HCl}$$

$$87 \text{ g MnO}_2 \text{ requires} = 4 \times 36.5 \text{ g HCl}$$

$$1 \text{ g MnO}_2 \text{ requires} = \frac{4 \times 36.5}{87} \text{ g HCl}$$

$$5 \text{ g MnO}_2 \text{ requires} = \frac{5 \times 4 \times 36.5}{87} \text{ g HCl}$$

$$= 8.39 \text{ g HCl}$$

6. Mass of S = $1 \times \frac{0.032}{100} = 3.2 \times 10^{-4} \text{ g}$

$$\text{mol of S} = \frac{3.2 \times 10^{-4}}{32} = 10^{-5} \text{ mol (mol of amino}$$

acid)

$$\text{molecules of amino acid} = 10^{-5} \times N_A$$

$$= 6.023 \times 10^{18} \text{ molecules}$$

7. $\text{PbO} + 2\text{NO}_2 + \frac{1}{2} \text{O}_2 \rightarrow \text{Pb}(\text{NO}_3)_2$

$$n_{\text{PbO}} = \frac{446}{223} = 2$$

$$n_{\text{NO}_2} = \frac{46}{46} = 1$$

$$n_{\text{O}_2} = \frac{16}{32} = 0.5$$

$$\frac{2}{1} ; \frac{1}{2} ; \frac{0.5}{0.5} = \frac{\text{mole}}{\text{Stoichiometric coefficient}}$$

So NO_2 is limiting reagent

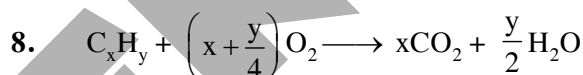
$$2 \text{ mol NO}_2 \text{ will give} = 1 \text{ mol Pb}(\text{NO}_3)_2$$

$$1 \text{ mol NO}_2 \text{ will give} = \frac{1}{2} \text{ mol Pb}(\text{NO}_3)_2$$

$$= 0.5 \text{ mol} \times \text{molar mass (g)}$$

$$= 0.5 \times 331$$

$$= 165.5 \text{ g}$$



$$\text{mol of CO}_2 = \frac{88}{44} = 2 \text{ mole}$$

$$x = 2$$

$$\text{mol of H}_2\text{O} = \frac{36}{18} = 2$$

$$\frac{y}{2} = 2$$

$$y = 4$$

but mass of organic compound is

$$44 = 12 \times 2 + 4 \times 1 + \text{mass of oxygen}$$

$$44 - 28 = \text{mass of oxygen}$$

$$\text{mass of oxygen} = 16 = 1 \text{ mol of oxygen atom}$$

$$\text{hence formula} = \text{C}_2\text{H}_4\text{O}$$

9. $\text{mol of CO}_2 = \frac{0.22}{44} = \frac{1}{200}$

$$\text{mol of H}_2 = \frac{0.01}{2} = \frac{1}{200} \text{ mol}$$

$$\text{mol of NH}_3 = \frac{0.085}{17} = \frac{1}{200} \text{ mol}$$

$$\text{mol of SO}_2 = \frac{320}{1000 \times 64} = \frac{1}{200} \text{ mol}$$

10. $0.1 \text{ g atom C} = 12 \times 0.1 = 1.2 \text{ g}$
 $0.1 \text{ mol NH}_3 = 17 \times 0.1 = 1.7 \text{ g}$
 $6.02 \times 10^{22} \text{ molecules of H}_2$

$$= \frac{6.02 \times 10^{22}}{6.02 \times 10^{23}} \times 2 \text{ g} = 0.2 \text{ g}$$

 $1120 \text{ mL of CO}_2 \text{ at NTP}$

$$= \frac{1120}{22400} \times 44 \text{ g} = 2.2 \text{ g}$$

 2.2 g is highest mass
11. $\text{H}_2\text{SO}_4 + \text{NaCl} \longrightarrow \text{NaHSO}_4 + \text{HCl}$

$$\begin{array}{cccc} \downarrow & \downarrow & \downarrow & \downarrow \\ 98 \text{ g} & x & 120 \text{ g} & 27.5 \text{ g} \end{array}$$

 Since balanced reaction follows law of conservation of mass
 $98 + x = 120 + 27.5$
 $x = 147.5 - 98.0$
 $x = 49.5 \text{ g}$

12. Ratio of moles = $\frac{x}{32} : \frac{x}{2} : \frac{x}{16}$
 of O_2 , H_2 and $\text{CH}_4 = 1 : 16 : 2$
13. $\text{NH}_3(\text{g}) + \text{HCl}(\text{g}) \longrightarrow \text{NH}_4\text{Cl}(\text{s})$

$$\begin{array}{cc} 20 & 40 \\ \text{NH}_3 \text{ is LR So final volume of gas remained} & = 20 \text{ cc} \end{array}$$

14.

	Moles	Molecules	Atoms
C_4H_{10}	$\frac{1}{58}$	$\frac{N_A}{58}$	$\frac{14N_A}{58}$
N_2	$\frac{1}{28}$	$\frac{N_A}{28}$	$\frac{2N_A}{28}$
Ag	$\frac{1}{108}$	—	$\frac{N_A}{108}$
H_2O	$\frac{1}{18}$	$\frac{N_A}{18}$	$\frac{3N_A}{18}$

15. Atomic mass of X = $\frac{6.664 \times 10^{-23}}{1.66 \times 10^{-24}} = 40$
 $\text{no. of g atom} = \text{no. of mol} = \frac{40 \times 10^3}{40} = 10^3$

16. $4\text{A} + 2\text{B} + 3\text{C} \longrightarrow \text{A}_4\text{B}_2\text{C}_3$

$$\begin{array}{ccc} 1 \text{ mol} & 0.6 \text{ mol} & 0.72 \text{ mol} \\ \frac{1}{4} & \frac{0.6}{2} & \frac{0.72}{3} \\ 0.25 & 0.3 & 0.24 \end{array}$$

 (C) is LR
 $3 \text{ mol of C will give} = 1 \text{ mol product}$
 $1 \text{ mol of C will give} = \frac{1}{3} \text{ mol product}$

$$0.72 \text{ mol will give} = \frac{0.72}{3} = 0.24 \text{ mol}$$

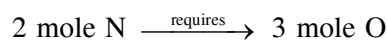
17. $\text{Ca}_3(\text{PO}_4)_2 : \text{P} : \text{O}$

$$\begin{array}{ccc} 1 & : & 2 : 8 \\ \therefore \frac{1}{2} & : & 1 : 4 \\ \text{H}_3\text{PO}_3 & : & \text{P} : \text{O} \\ 1 & : & 1 : 3 \end{array}$$

18. $\text{N}_2 \text{ converted} = 80\% \text{ or } 7 \text{ gm}$

$$= 7 \times \frac{80}{100} = 5.6 \text{ gm}$$

$$\text{moles of N} = \frac{5.6}{14} = 0.4 \text{ mole}$$



$$\begin{aligned} 0.4 \text{ mole N} &\longrightarrow 0.6 \text{ mole O} \\ &= 0.6 \times (6 \times 10^{23}) \\ &= 3.6 \times 10^{23} \text{ atoms} \end{aligned}$$

19. The mass of O atoms = $1.16 - 1.00 = 0.160 \text{ g}$

$$\text{Number of moles of O atoms} = \frac{0.160}{16} = 0.01$$

$$\text{In } \text{X}_2\text{O}_3 \quad \frac{\text{No. of moles of X}}{\text{No. of moles of O}} = \frac{2}{3}$$

$$\text{No. of moles of X} = \frac{2}{3} \times 0.01 = \frac{0.02}{3} = 0.00666$$

$$\begin{aligned} \text{No. of moles of X} &= \frac{\text{mass in g}}{\text{no. of moles}} \\ &= \frac{1.0}{0.00666} = 150 \end{aligned}$$

20. Let % of oxygen = x

$$\% \text{ of H} = \frac{1}{6} \times \% \text{ of C} = \frac{1.5x}{6}$$

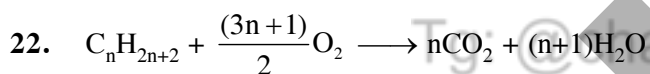
$$\% \text{ C} = 1.5 \times \% \text{ of O} = 1.5 \times x$$

element	%	A	%/A	Simple ratio
C	1.5 x	12	$\frac{1.5x}{12}$	$\frac{1.5x}{12} \times 16 = 2$
H	$\frac{1.5x}{6}$	1	$\frac{1.5x}{6}$	$\frac{1.5x}{6} \times 16 = 4$
O	x	16	$\frac{x}{16}$	= 1

Empirical formula = $\text{C}_2\text{H}_4\text{O}$

21. From the given mol ratio of Fe_2S_3 , H_2O and O_2 i.e. 1 : 2 : 3 and molar ratio in the reaction i.e., 2 : 6 : 3, it is clear that the H_2O is the limiting reagent as H_2O shall be fully consumed in the reaction. Thus, moles of $\text{Fe}(\text{OH})_3$ produced by

$$2 \text{ moles of } \text{H}_2\text{O} = \frac{4}{6} \times 2 = 1.34$$



ATQ: $\frac{\left\{\frac{3n+1}{2}\right\}}{n} = \frac{7}{4}$

$$\Rightarrow 2(3n+1) = 7n$$

$$\Rightarrow n = 2$$

$$\therefore \text{C}_n\text{H}_{2n+2} = \text{C}_2\text{H}_6$$

23. I oxide = MO

$$\text{M} : \text{O}$$

$$\text{mol: } \frac{77.78}{\text{M}} : \frac{22.22}{16} = 1 : 1$$

$$\Rightarrow \text{M} = 56$$

II oxide = ?

$$\text{M} : \text{O}$$

$$\text{mol: } \frac{70}{56} : \frac{30}{16}$$

$$= 2 : 3 \therefore \text{M}_2\text{O}_3$$

24. Mass of nitrogen in 194 amu caffeine

$$= \frac{29}{100} \times 194 = 56.26$$

$\therefore$ One molecule of caffeine 4 atoms of nitrogen

ATOMIC STRUCTURE

1. Ionisation energy of $\text{He}^{\oplus}$ ion = $E_{\infty} - E_1$

$$= 0 - (-21.8 \times 10^{-18} \times \frac{4}{1})$$

$$= 8.72 \times 10^{-18} \text{ J}$$

2. $r_{(n+1)} - r_n = r_{(n-1)}$

$$\Rightarrow 0.529 \times \frac{(n+1)^2}{Z} \text{ \AA} - 0.529 \times \frac{n^2}{Z} \text{ \AA} = 0.529 \times \frac{(n-1)^2}{Z} \text{ \AA}$$

$$\Rightarrow (n+1)^2 - n^2 = (n-1)^2$$

$$\Rightarrow (n^2 + 2n + 1) - n^2 = n^2 - 2n + 1$$

$$\Rightarrow 2n = n^2 - 2n$$

$$\Rightarrow n^2 = 4n$$

$$\Rightarrow n = 4$$

3. Potential energy of electron

$$= \frac{-\text{Nuclear charge} \times \text{charge on electron}}{\text{Radius of orbit}}$$

$$= -\frac{Ze \times 6e}{r}$$

$$= -\frac{6Ze^2}{r}$$

4. de Broglie wavelength $\lambda = \frac{h}{\sqrt{2mqV}}$
 $V = \text{Potential by which charged particles are accelerated}$

$$\therefore \frac{\lambda_{\text{Be}^{+3}}}{\lambda_p} = \frac{\sqrt{2m_p q_p V}}{\sqrt{2m_{\text{Be}^{+3}} q_{\text{Be}^{+3}} V}}$$

$$= \sqrt{\frac{m_p q_p}{9m_p \times 3q_p}} = \frac{1}{\sqrt{27}} \quad [\because V \text{ is same}]$$

therefore ratio $\lambda_{\text{Be}^{+3}} : \lambda_p = 1 : 3\sqrt{3}$

5. Ionisation energy of ion = $E_{\infty} - E_1 = 217.6 \text{ eV}$
 therefore $E_1 = -217.6 \text{ eV} = -13.6 \times \frac{Z^2}{1^2}$

$$\therefore Z^2 = \frac{217.6}{13.6} = 16 \text{ and } Z = 4$$
 thus in beryllium ($Z = 4$) ion no. of neutrons

$$= 9 - 4 = 5$$

6. Energy of 1 photon = $\frac{hc}{\lambda} = \frac{6.62 \times 10^{-34} \times 3 \times 10^8}{5893 \times 10^{-10}}$

$$= 3.37 \times 10^{-19} \text{ J}$$

Total energy emitted by sodium lamp

$$= 60 \text{ Watt} = 60 \text{ J/sec}$$

$\therefore$ Number of photon emitted in

1 sec = $\frac{60}{3.37 \times 10^{-19}}$ and in 10 hours

Total no. of emitted photons = $\frac{10 \times 3600 \times 60}{3.37 \times 10^{-19}}$

$$= 6.4 \times 10^{24}$$

7. Distance between 3rd and 2nd orbit of H atom

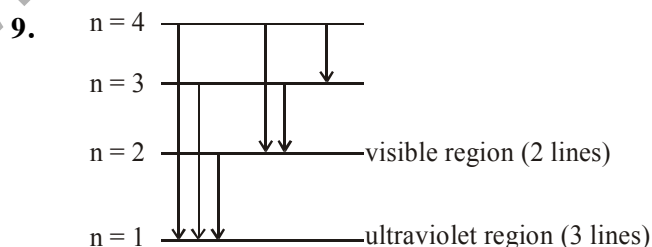
$$= r_3 - r_2$$

$$= 0.529 \times 10^{-8} \left(\frac{3^2}{1} - \frac{2^2}{1} \right) \text{ cm.}$$

$$= 5 \times 0.529 \times 10^{-8} = 2.646 \times 10^{-8} \text{ cm}$$

8. Wavelength of $e_{(\lambda)}^{\ominus} = \text{Velocity of } e^{\ominus}(v)$

$$\therefore \lambda = v = \frac{h}{mv} \text{ or } v^2 = \frac{h}{m} \text{ and } v = \sqrt{\frac{h}{m}}$$



10. Spherical node is not present for 1s orbital

11. Angular momentum is integral multiple of $\frac{h}{2\pi}$ in successive orbits.

12. $\Delta x \times \Delta p \approx \frac{h}{4\pi}$

Since $\Delta x = \Delta p$ therefore, $(\Delta p)^2 = \frac{h}{4\pi}$

or $\Delta p = m\Delta v = \sqrt{\frac{h}{4\pi}}$ and $\Delta v = \frac{1}{2m} \sqrt{\frac{h}{\pi}}$

13. Circumference of 4th orbit = $2\pi r_4$

and angular momentum $mvr_4 = \frac{4h}{2\pi}$... (i)

de-broglie wavelength $\lambda = \frac{h}{mv}$ & $mv = \frac{h}{\lambda}$... (ii)

therefore from eq.(1) and (ii)

$$\frac{h}{\lambda} r_4 = \frac{4h}{2\pi} \quad \text{or } 2\pi r_4 = 4\lambda$$

and circumference of 4th orbit is equal to 4 times to wavelength of electron.

14. $\Delta v = 1 \text{ cms}^{-1}$

$\Delta x = ?$

$$\Delta x = \frac{h}{4\pi m \times \Delta v}$$

$$= \frac{6.626 \times 10^{-34} \text{ Js}}{4 \times 3.14 \times 10^{-3} \text{ kg} \times 10^{-2} \text{ ms}^{-1}}$$

$$= 5.25 \times 10^{-30} \text{ m}$$

15. E_1 (for H) = $-13.6 \times \frac{1}{1}$

and E_2 (for Be^{+3}) = $-13.6 \times \frac{4^2}{2^2}$

$$\text{therefore, } \frac{E_1}{E_2} = \frac{-13.6}{-13.6 \times 4} = \frac{1}{4}$$

16. Ionisation energy of Li^{+2} ion = $0 - \left(13.6 \times \frac{3^2}{1^2}\right)$
= 122.4 eV

and Ionisation energy of H atom = $0 - \left(13.6 \times \frac{1^2}{1^2}\right)$
= 13.6 eV

$\therefore$ I.E. (of Li^{+2}) = $9 \times$ I.E. (of H)

17. Wavelength of 4th line of Balmer series λ_4

$$= \frac{1}{R_H \left(\frac{1}{4} - \frac{1}{36} \right)} = 912 \times \frac{9}{2} \text{ \AA}$$

and wavelength of 5th line of Balmer series λ_5

$$= \frac{1}{R_H \left(\frac{1}{4} - \frac{1}{49} \right)} = \frac{912 \times 196}{45} \text{ \AA}$$

therefore $\lambda_4 - \lambda_5 = 912 \left(\frac{9}{2} - \frac{196}{45} \right) = 131.7 \text{ \AA}$

18. In H-atom $r_i - r_f = 7 \times 0.529 \text{ \AA}$

therefore $0.529 \times n_i^2 - 0.529 n_f^2$
= 7×0.529 or $n_i^2 - n_f^2 = 7$

thus the electronic transition is from 4th orbit to 3rd orbit

19. De-broglie wavelength $\lambda = \frac{h}{mv}$

$$\frac{\lambda_{\text{ball}}}{\lambda_{e^-}} = \frac{h}{m_{\text{ball}} v} \times \frac{m_{e^-} v}{h} = \frac{9.1 \times 10^{-31}}{0.91}$$

$$\therefore \lambda_{\text{ball}} : \lambda_{e^-} = 10^{-30} : 1$$

20. Circumference of orbit $2\pi r = n\lambda$

and for 4th orbit $2\pi r_4 = 4\lambda = 5.32 \text{ nm}$

$$\text{therefore } \lambda = \frac{5.32}{4} = 1.33 \text{ nm}$$

21. In H-atom ionisation energy is less than 1 eV is for $n = 4$ ($E_4 = -0.85 \text{ eV}$) on wards. therefore minimum value of $n = 4$.

22. $(n - 1)d$ subshell has higher energy than ns subshell for example $5d$ subshell has higher energy than $6s$ subshell.

23. An orbital can be represented by using three quantum numbers n , ℓ and m .

$$24. \Delta E_1 = E_{n_2} - E_{n_1}$$

$$\Delta E_2 = E_{n_3} - E_{n_2}$$

$$\Delta E_3 = E_{n_3} - E_{n_1}$$

therefore $\Delta E_3 = \Delta E_1 + \Delta E_2$ and $\nu_3 = \nu_1 + \nu_2$
($\because E \propto \nu$)

and also $\bar{\nu}_3 = \bar{\nu}_1 + \bar{\nu}_2$ ($\because E \propto \frac{1}{\lambda}$ or $E \propto \bar{\nu}$)

25. Electronic config. of Cr
 $= 1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$ for electrons with
 $n + m = 3$ in Cr there are 3 possibilities.
 (i) $n = 2, m = +1 \Rightarrow$ for two 2p electrons
 (ii) $n = 3, m = 0 \Rightarrow$ for two 3s electrons +
 two 3p electrons + one 3d electron.
 (iii) $n = 4, m = -1 \Rightarrow$ no electron of this type
 therefore totally 7 electrons are in Cr with
 $n + m = 3$

26. $\lambda = \frac{h}{p}; \frac{\lambda_A = \frac{h}{P_A}}{\lambda_B = \frac{h}{P_B}} = \frac{P_B}{P_A}$

$$\therefore \lambda_B = \frac{\lambda_A \times P_A}{P_B} = \frac{5 \times 10^{-8} \times P_A}{P_A / 2}$$

$$\therefore \lambda_B = 10^{-7} \text{ m.}$$

27. $n_2 + n_1 = 4$ (i) and
 $n_2^2 - n_1^2 = 8$ (ii)
 therefore $n_2 = 4 - n_1$
 and from equation (ii) $(4 - n_1)^2 - n_1^2 = 8$
 $16 - 8n_1 + n_1^2 - n_1^2 = 8$
 or $n_1 = 1$
 and $n_2 = 4 - 1 = 3$

$$\lambda = \frac{1}{R_H \times Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)} = \frac{1}{R_H \times 4 \left(\frac{1}{1} - \frac{1}{9} \right)}$$

$$\therefore \lambda = \frac{9}{32 R_H}$$

28. $I.E._{(SES)} = -E_{1(H)} \times Z^2$
 $\Rightarrow 19.6 \times 10^{-18} \text{ J} = -E_{1(H)} \times Z^2$
 $\Rightarrow E_{1(H)} = \frac{-19.6 \times 10^{-18} \text{ J}}{4}$
 $= -4.9 \times 10^{-18} \text{ J}$
 $\therefore E \propto -Z^2$
 $\therefore \frac{E_{(H)}}{E_{(Li^{2+})}} = \frac{Z_H^2}{Z_{Li^{2+}}^2}$
 $\Rightarrow \frac{-4.9 \times 10^{-18} \text{ J}}{?} = \frac{1^2}{3^2} \Rightarrow ? = -44.1 \times 10^{-18} \text{ J}$

29. $\nu = R_H C Z^2 \left\{ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right\}$

$$n_1 = 2, n_2 = 4$$

$$\nu = 1.09 \times 10^7 \times 3 \times 10^8 \times 1^1 \left\{ \frac{1}{2^2} - \frac{1}{4^2} \right\}$$

$$\nu = 6.15 \times 10^{14} \text{ Hz}$$

30. $\lambda = \frac{h}{\sqrt{2 \times m \times K.E.}}$

$$= \frac{6.6 \times 10^{-34}}{\sqrt{2 \times 9.1 \times 10^{-31} \text{ kg} \times 4.55 \times 10^{-25}}}$$

$$= 7.25 \times 10^{-7} \text{ m}$$

31. From $\lambda = \frac{h}{p}$

$$\lambda_e = \lambda_{\text{photon}}$$

$$\Rightarrow \frac{h}{mv} = 5200 \times 10^{-10} \text{ m}$$

$$\Rightarrow v = \frac{6.6 \times 10^{-34} \text{ Js}}{9.1 \times 10^{-31} \text{ kg} \times 5200 \times 10^{-10} \text{ m}}$$

$$= 1400 \text{ ms}^{-1}$$

32. Given, $mvr = \frac{nh}{2\pi}$

$$\therefore \frac{nh}{2\pi} = 4.2178 \times 10^{-34}$$

$$\text{or } n = \frac{4.2178 \times 10^{-34} \times 2 \times 3.14}{6.625 \times 10^{-34}} = 4$$

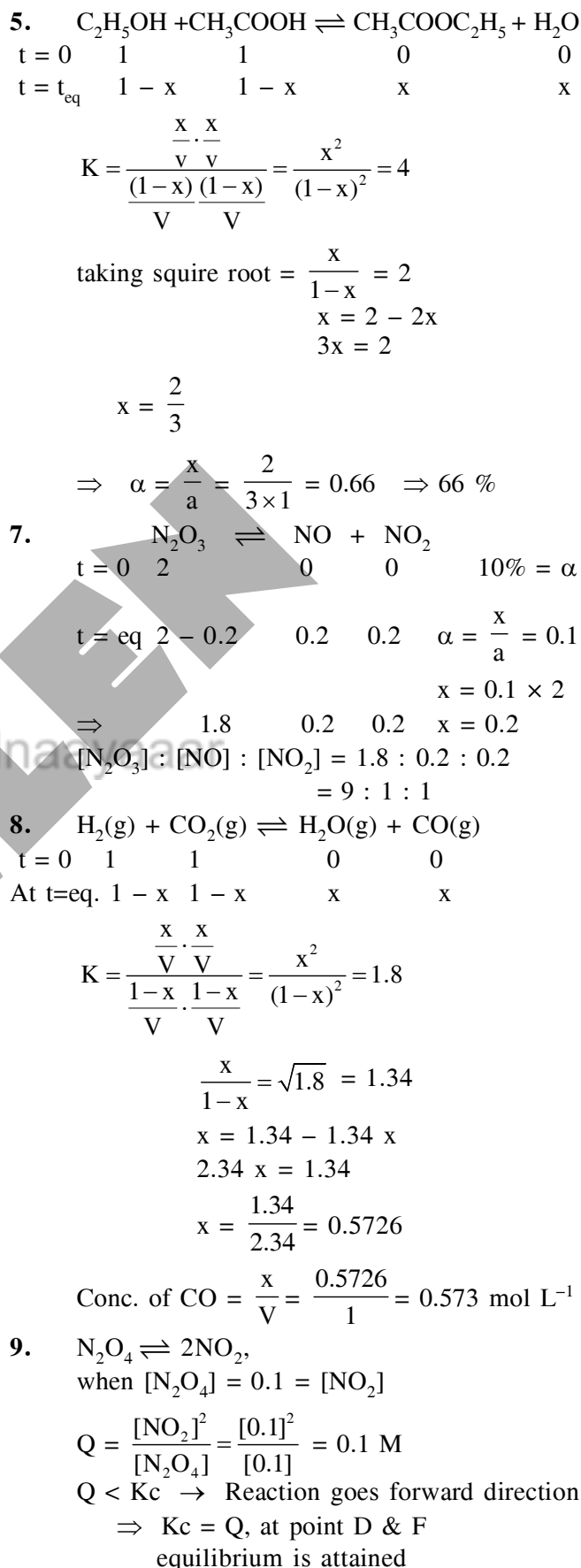
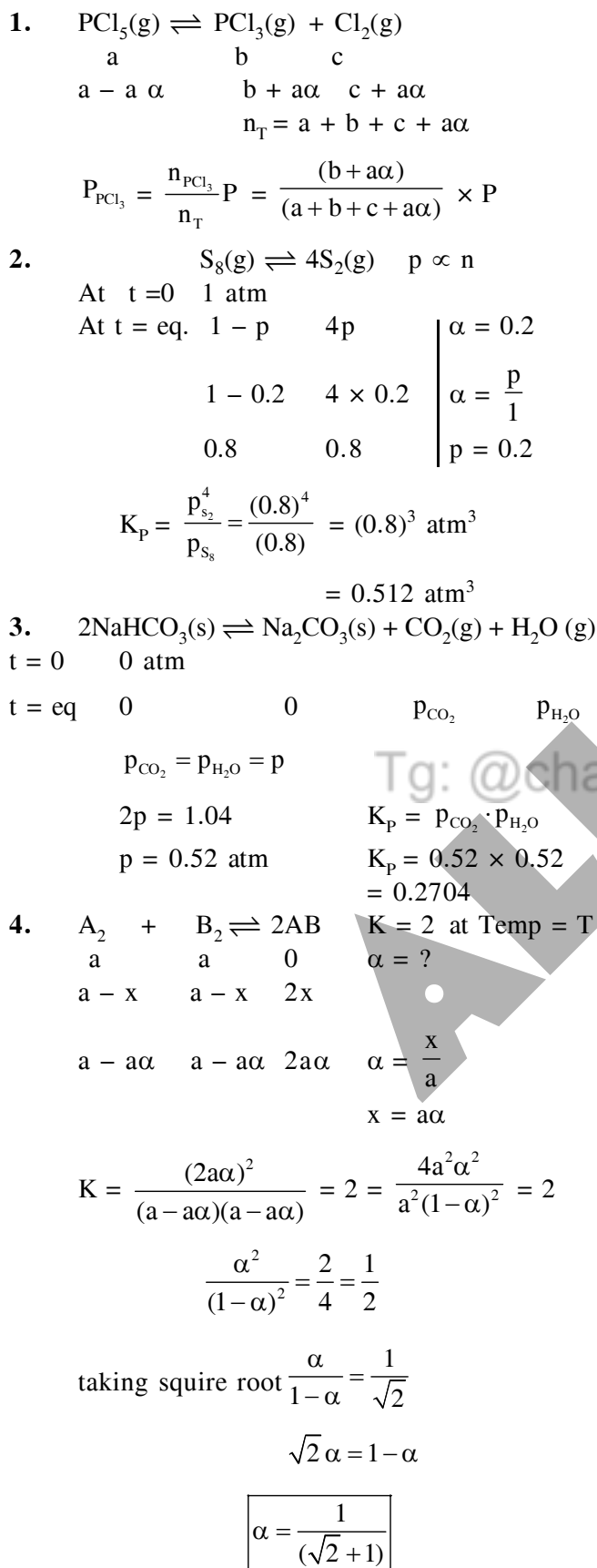
$$\text{Thus, } \frac{1}{\lambda} = R_H \left[\frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$$

The transition spectral line for 4th to 3rd shell is

$$\frac{1}{\lambda} = 109678 \left[\frac{1}{3^2} - \frac{1}{4^2} \right]$$

$$\lambda = 1.8 \times 10^{-4} \text{ cm}$$

CHEMICAL EQUILIBRIUM



$$10. \quad A + 2B \rightleftharpoons C \quad K_1 = \frac{[C]}{[B]^2[A]}$$

$$C + D \rightleftharpoons 3A \quad K_2 = \frac{[A]^3}{[C][D]}$$

$$6B + D \rightleftharpoons 2C \quad K_3 = \frac{[C]^2}{[D][B]^6}$$

$$K_1^3 \cdot K_2 = \frac{[C]^3}{[B]^6[A]^3} \cdot \frac{[A]^3}{[C][D]} = \frac{[C]^2}{[B]^6[D]}$$

$$\boxed{K_1^3 \cdot K_2 = K_3}$$

$$12. \quad (K_{eq})_1 = \frac{[SO_3]^2}{[SO_2]^2[O_2]} = \frac{[0.1]^2}{[0.1]^2[0.1]} = 10$$

$$(K_{eq})_2 = \frac{[NH_3]^2}{[N_2][H_2]^3} = \frac{[0.1]^2}{[0.1][0.1]^3} = 100$$

$$(K_{eq})_3 = \frac{[NO_2]^2}{[N_2O_4]} = \frac{[0.1]^2}{[0.1]} = 0.1$$

$$(K_{eq})_4 = \frac{[NH_3]^4[O_2]^5}{[NO]^4[H_2O]^6} = \frac{(0.1)^9}{(0.1)^{10}} = 10$$

extent $\propto k_{eq}$: II > I = IV > III

$$13. \quad \begin{array}{ccc} 2NOBr(g) & \rightleftharpoons & 2NO(g) + Br_2(g) \\ t = 0 & p^\circ & 0 \quad 0 \\ & p^\circ - 0.4p^\circ & 0.4p^\circ \quad 0.2p^\circ \\ & 0.6p^\circ & 0.4p^\circ \quad 0.2p^\circ \\ p_T = p^\circ + 0.2p^\circ = 0.30 \\ & & 1.2 p^\circ = 0.3 \\ & & p^\circ = \frac{0.3}{1.2} = \frac{1}{4} = 0.25 \text{ atm} \end{array}$$

$$K_p = \frac{(0.4p^\circ)^2(0.2p^\circ)}{(0.6p^\circ)^2}$$

$$= \frac{4}{6} \times \frac{4}{6} \times 0.2 \times 0.25$$

$$= \frac{4}{9} \times 0.2 \times 0.25$$

$$K_p = \frac{0.2}{90} = \frac{1}{45}$$

Then K_p^1 for $2NO(g) + Br_2(g) \rightleftharpoons 2NOBr(g)$

$$\text{will be} = \frac{1}{K_p} = \frac{1}{1/45} = 45$$

$$14. \quad A(g) \rightleftharpoons B(g) \quad \text{if total mole} = a$$

$$\text{moles of B} = \frac{a \times 40}{100} = 0.4a$$

$$\text{moles of A} = \frac{a \times 60}{100} = 0.6a$$

$$K_{eq} = \frac{0.4a}{0.6a} = 0.67$$

$$15. \quad H_2(g) + S(s) \rightleftharpoons H_2S(g)$$

$$\log \frac{K_2}{K_1} = \frac{\Delta H}{2.303R} \left(\frac{1}{T_1} - \frac{1}{T_2} \right)$$

$$\log \left(\frac{9.25}{18.5} = \frac{1}{2} \right) = \frac{\Delta H}{2.303 \times 8.314} \left(\frac{1}{925} - \frac{1}{1000} \right)$$

$$-0.3010 = \frac{\Delta H}{2.30 \times 8.314} \left(\frac{75}{925 \times 1000} \right)$$

$$\Delta H = -71080.57 \text{ J/mole}$$

$$16. \quad Q_c = \frac{(NH_3)^2}{(N_2) \times (H_2)^3} = \frac{(0.5)^2}{3 \times (2)^3} = \frac{0.25}{24} = 0.0104$$

$$Q_c < K_c$$

reaction will go in forward direction.

$$17. \quad \text{For exothermic process as } T \uparrow \text{ yield } \downarrow$$

so $T_1 > T_2 > T_3$

$$19. \quad NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$$

$$t = t_{eq} \quad \begin{array}{ccc} & P' & P' \\ 25 = P' + P' \Rightarrow (P')^2 = 25 \Rightarrow P' = 5 \text{ atm} \end{array}$$

Total pressure at equilibrium

$$= P' + P' = 5 + 5 = 10 \text{ atm}$$

$$20. \quad \Delta G^\circ = -2.303 RT \log K_{eq}$$

$$X.1000 = -2.303 \times 2 \times 300 \times \log 100$$

$$X = -2.7636$$

IONIC EQUILIBRIUM

1. $\text{NH}_4\text{CN} \longrightarrow \text{NH}_4^+ + \text{CN}^-$
pH of hydrolysis of salt WA + WB is independent of conc. of salt.

2. $\text{POH} = 7 - \frac{1}{2} (\text{pk}_a - \text{pk}_b)$ is formula for {WA + WB} salt hydrolysis.

3. $\text{Hg}_2\text{Cl}_2(\text{s}) \rightleftharpoons \text{Hg}_2^{+2}(\text{aq}) + 2\text{Cl}^-(\text{aq})$
s 2s
 $K_{\text{sp}} = s(2s)^2$; $K_{\text{sp}} = 4s^3 \Rightarrow s = \left(\frac{K_{\text{sp}}}{4}\right)^{\frac{1}{3}}$
4. $\text{Ca}_3(\text{PO}_4)_2 \rightleftharpoons 3\text{Ca}^{+2}(\text{aq}) + 2\text{PO}_4^{-3}(\text{aq})$
3s 2s
 $s = \text{wg}/100 \text{ mL} = w \times 10 \text{ g}/1000 \text{ mL}$

$$\Rightarrow 10w \text{ g/L} \Rightarrow \frac{10W}{M} \text{ mol/L}$$

$$\text{Then } K_{\text{sp}} = (3s)^3 (2s)^2$$

$$= 27 \times 4 s^5 = 108 \left(\frac{10W}{M}\right)^5$$

$$\Rightarrow 108 \times 10^5 \left(\frac{W}{M}\right)^5 ; K_{\text{sp}} \Rightarrow 10^7 \left(\frac{W}{M}\right)^5$$

5. $\text{NaX} \longrightarrow \text{Na}^+ + \text{X}^-$ ($K_a = 10^{-5}$)
0.1 M 0.1 0.1
 $\text{X}^- + \text{H}_2\text{O} \rightleftharpoons \text{HX} + \text{OH}^-$

$$h = \sqrt{\frac{K_h}{C}} \Rightarrow \sqrt{\frac{K_w}{K_a \cdot C}}$$

$$= \sqrt{\frac{10^{-14}}{10^{-5} \times 0.1}} = \sqrt{10^{-8}} = 10^{-4}$$

$$h = 10^{-4}$$

$$\% h = 10^{-4} \times 100 = 10^{-2} = 0.01 \%$$

6. $\text{CH}_3\text{COOH} + \text{H}_2\text{O} \rightleftharpoons \text{CH}_3\text{COO}^- + \text{H}_3\text{O}^+$
WA WB SB SA

Strong Acid (H_3O^+) conjugate base will be H_2O

7. pH = 13

$$[\text{H}^+] = 10^{-13} \text{ M}$$

$$\text{mol of } \text{H}^+ = MV = 10^{-13} \times \frac{1}{1000} = 10^{-16} \text{ mole}$$

$$\text{No. of ions} = \text{Mol} \times N_A = 10^{-16} \times 6.023 \times 10^{23} = 6.023 \times 10^7$$

8. $\frac{M_1 V_1 - M_2 V_2}{V_1 + V_2} = 0.1$ for getting pH = 1

$$\Rightarrow \frac{75 \times \frac{1}{5} - 25 \times \frac{1}{5}}{75 + 25} = \frac{15 - 5}{100} = \frac{10}{100} = 0.1$$

9. $\text{NaCl} + \text{NaOH}$ Never form a buffer
[Salt of (SA + SB) + strong base]

10. $\text{MX}_{(\text{aq})} \rightleftharpoons \text{M}^+_{(\text{aq})} + \text{X}^-_{(\text{aq})}$

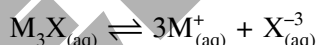
$$K_{\text{SP}} = S_1^2 \Rightarrow S_1 = \sqrt{K_{\text{SP}}} = \sqrt{4 \times 10^{-8}} = 2 \times 10^{-4} \text{ mole/litre}$$



$$K_{\text{SP}} = 4S_2^3 \Rightarrow S_2^3 = \frac{K_{\text{SP}}}{4} = \frac{3.2 \times 10^{-14}}{4}$$

$$= 0.8 \times 10^{-14} = 8 \times 10^{-15}$$

$$S_2 = 2 \times 10^{-5} \text{ mole/litre}$$



$$K_{\text{SP}} = 27S_3^4 \Rightarrow S_3^4 = \frac{K_{\text{SP}}}{27} = \frac{2.7 \times 10^{-15}}{27}$$

$$S_3 = 10^{-4} \text{ mole/litre}$$

11. $\text{NH}_3^+ - \text{CH}_2 - \text{COO}^- \longrightarrow \text{NH}_3^+ - \text{CH}_2 - \text{COOH}$

(zwitter ion) (conjugate base)

$\text{NH}_2\text{CH}_2\text{COO}^-$ (conjugate acid)

12. $\text{A} \rightarrow \text{CH}_3\text{COONa} \rightarrow \text{Salt (aq. solution basic)}$

$\text{B} \rightarrow \text{CH}_3\text{COOH}/\text{CH}_3\text{COONa}$

$\rightarrow$ pH. of acidic buffer

$\text{C} \rightarrow \text{CH}_3\text{COOH} \rightarrow \text{weak acid}$

$\text{A} > \text{B} > \text{C}$

13. $\alpha = \sqrt{\frac{K_a}{C}} ; \alpha = \sqrt{\frac{10^{-5}}{5 \times 10^{-2}}} = 1.414 \times 10^{-2}$

$$\alpha \% = 1.4 \%$$

14. $\text{pH} = 7 + \frac{1}{2} (\text{pk}_a + \log C)$

$$= 7 + \frac{1}{2} (5 - \log 2 + \log 5 \times 10^{-2})$$

$$= 7 + \frac{1}{2} (5 - 0.30 + 0.7 - 2) = 7 + \frac{1}{2} (3.4)$$

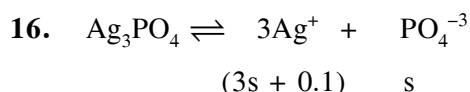
$$\Rightarrow \text{pH} = 8.7$$

$$15. \quad \text{pH} = \frac{1}{2} \text{p}K_a - \frac{1}{2} \log C$$

$$= \frac{1}{2} (4 - \log 10^{-2}) \quad \left| \quad C = \frac{2 \times 0.09}{180} \times \frac{1000}{100} \right.$$

$$= \frac{1}{2} (4 + 2) \quad \left| \quad C = \frac{18 \times 10^{-2}}{18} \text{ M} \right.$$

$$= 3$$



$$K_{sp} = (3s + 0.1)^3 (s) = 1.1 \times 10^{-16}$$

$$10^{-3} \times s = 1.1 \times 10^{-16}$$

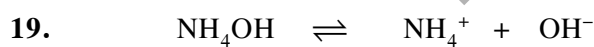
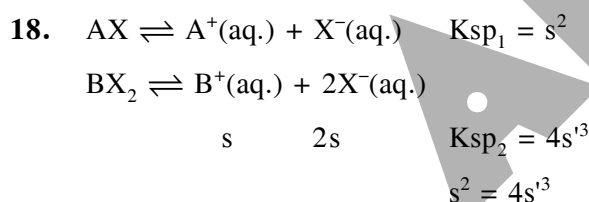
$$s = 1.1 \times 10^{-13}$$

$$17. \quad \text{pH} = \text{p}K_{\text{In}} + \log \left(\frac{[\text{In}^-]}{[\text{HIn}]} \right)$$

$$5.48 = \text{p}K_{\text{In}} + \log \left(\frac{75}{25} \right)$$

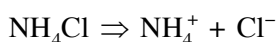
$$\text{p}K_{\text{In}} = 5.48 - \log 3 = 5.48 - 0.48 = 5$$

$$K_{\text{In}} = 1 \times 10^{-5}$$



$$t = 0 \quad 0.01 \quad \quad 0 \quad \quad 0$$

$$t_{\text{eq}} \quad 0.01 - 0.01\alpha \quad (0.01\alpha + 0.01) \quad 0.01\alpha$$



$$0.01 \quad \quad 0.01 \quad 0.01$$

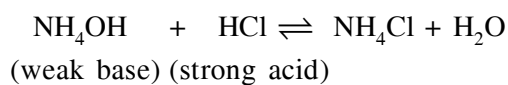
$$K_b = \frac{(0.01\alpha)(0.01\alpha + 0.01)}{0.01(1 - \alpha)}$$

$$2 \times 10^{-5} = 0.01\alpha (1 + \alpha)$$

$$\alpha = 2 \times 10^{-3}$$

$$\% \alpha = 2 \times 10^{-3} \times 100 = 0.2$$

20. Combination of weak base (NH_4OH) and its salt with strong acid (NH_4Cl) act as basic buffer solution



$$\begin{array}{ccccccc} \text{Initial} & 2 \text{ mole} & 1 \text{ mole} & 0 & 0 & & \\ \text{After} & (2-1) & (1-1) & 1 \text{ mole} & 1 \text{ mole} & & \\ \text{reaction} & = 1 \text{ mole} & = 0 & & & & \end{array}$$

1 mole NH_4OH & 1 mole NH_4Cl are present in mixture after reaction. Hence it will also act as basic buffer.

$$22. \quad [\text{H}^+] = \frac{M_1 V_1 - M_2 V_2}{V_1 + V_2 + V_{\text{H}_2\text{O}}} = \frac{25 \times 0.5 - 10 \times 0.5}{35 + 15}$$

$$= \frac{7.5}{50} = \frac{3}{20}$$

$$\text{pH} = -\log [\text{H}^+]$$

$$-\log \left[\frac{3}{20} \right] = +\log 20 - \log 3$$

$$= 1.3 - 0.48 = 0.82$$

$$23. \quad \text{pH} = 7 + \frac{1}{2} (\text{p}K_a + \log C)$$

$$= 7 + \frac{1}{2} \left(10 - \log 5 + \log \frac{5}{10} \right)$$

$$= 7 + \frac{1}{2} [10 - \log 5 + \log 5 - \log 10]$$

$$= 7 + \frac{1}{2} [9]$$

$$\text{pH} = 11.5$$

$$24. \quad s^2 = 6.25 \times 10^{-18}$$

$$s = 2.5 \times 10^{-9}$$

$$\begin{aligned} M &= 2s = 2 \times 2.5 \times 10^{-9} \\ &= 5.0 \times 10^{-9} \text{ M} \end{aligned}$$

$$25. \quad \text{pH} = \text{p}K_a + \log \left(\frac{\text{Salt}}{\text{Acid}} \right)$$

$$10.4 = 9.4 + \log \left(\frac{0.01}{x} \right)$$

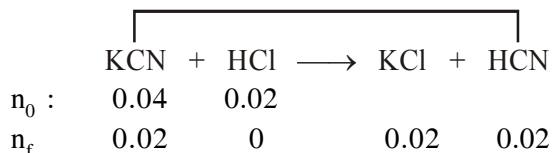
$$1 = \log \frac{0.01}{x}; \quad 10 = \frac{0.01}{x}$$

$$x = 0.001 = 10^{-3}$$

26. $[H^+]_1 = 10^{-3}$ $[H^+]_2 = 10^{-5}$

$$\frac{[H^+]_1}{[H^+]_2} = \frac{10^{-3}}{10^{-5}} = \frac{100}{1} \quad 100 : 1$$

27.



$$\therefore \text{pH} = \text{pK}_a + \log \frac{n_{\text{CN}^-}}{n_{\text{HCN}}}$$

$$\text{pH} = 6 + \log \frac{0.02}{0.02}$$

$$= 6$$

28.

I case

$$\text{pH} = 2$$

$$\therefore [H^+] = 10^{-2} \text{ M}$$

$$\therefore [\text{H}_2\text{SO}_4] = \frac{10^{-2}}{2} \text{ M} \quad \therefore [\text{H}_2\text{SO}_4] = \frac{10^{-3}}{2} \text{ M}$$

$$\therefore n_{\text{H}_2\text{SO}_4} = \frac{10^{-2}}{2} \times 1 \text{ mol} \quad \therefore n_{\text{H}_2\text{SO}_4} = \frac{10^{-3}}{2} \times 1 \text{ mol}$$

Now ATQ,

$$\frac{10^{-2}}{2} - n_{\text{H}_2\text{SO}_4} = \frac{10^{-3}}{2}$$

$$\therefore n_{\text{H}_2\text{SO}_4} = \frac{1}{2} \times 10^{-2} - \frac{1}{2} \times 10^{-3}$$

$$= \frac{1}{2} \times 0.009 \text{ mol}$$

$$\therefore w_{\text{H}_2\text{SO}_4} = \frac{1}{2} \times 0.009 \times 98 \text{ g}$$

$$= 0.009 \times 49 \text{ g}$$

$$= 0.441 \text{ g}$$

29. $\text{geq of HCl} = N \times V \text{ (in litre)}$

$$= 0.5 \times 20 \times 10^{-3}$$

$$= 10 \times 10^{-3}$$

Similarly; $\text{geq of NaOH (Base)} < \text{geq of HCl (acid)}$

Hence resultant mixture will be acidic colour.

Colour of methyl orange indicator in acidic medium is red.

30. $K_{sp} = 4s^3 = 4 \times (5 \times 10^{-6})^3$

$$= 4 \times 125 \times 10^{-18}$$

$$= 5 \times 10^{-16}$$

$$[\text{OH}^-] \text{ in buffer solution} = \frac{10^{-14}}{10^{-8}} = 10^{-6} \text{ M}$$

$$\therefore K_{sp} = [\text{Pb}^{2+}] [\text{OH}^-]^2$$

$$\Rightarrow 5 \times 10^{-16} = s \times (10^{-6})^2$$

$$s = \frac{5 \times 10^{-16}}{10^{-12}} = 5 \times 10^{-4} \text{ M}$$

THERMODYNAMICS AND THERMO CHEMISTRY

- More is formation enthalpy less the stability of product formed.
- $$\text{NaOH} + \text{HCl} \longrightarrow \text{NaCl} + \text{H}_2\text{O} \Rightarrow x$$

$$\frac{0.5 \times 20}{10} \quad \frac{0.1 \times 100}{10}$$

$$\therefore \Delta H \text{ for 10 mili mole} = -x \text{ kJ/mol}$$

$$\therefore \Delta H \text{ for 1 mole} = \frac{-x \times 1000}{10} = -100x$$

$$= \Delta H_n$$
- $$\text{CH}_4 + 3\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}, \Delta H = -z \text{ kJ} \quad \dots(1)$$

$$\text{C} + \text{O}_2 \longrightarrow \text{CO}_2, \Delta H = -x \text{ kJ} \quad \dots(2)$$

$$\text{H}_2 + \frac{1}{2} \text{O}_2 \longrightarrow \text{H}_2\text{O}, \Delta H = -y \text{ kJ} \quad \dots(3)$$

$$\text{eq. (2)} + 2 \times \text{eq. (3)} - \text{eq. (1)}$$

$$\text{C} + 2\text{H}_2 \longrightarrow \text{CH}_4 = (z - x - 2y) \text{ kJ}$$
- $$\Delta E = q + w \text{ for isothermal process } \Delta E = 0$$

$$q = -w$$

$$q = -w = -(-2.303 \times 10 \times 8.314 \times 300 \times \log 2)$$

$$= 1.728 \times 10^4 \text{ J}$$
- $\Delta S \propto \Delta n_g$
- All because expansion is occurring in all three reaction, and expansion work done is negative
- $$\text{(i) } \text{B}_2\text{H}_{6(g)} \longrightarrow 2\text{B}_{(s)} + 3\text{H}_{2(g)},$$

$$\Delta H_1 = -36 \text{ KJ mol}^{-1}$$

$$\text{(ii) } 2\text{B}_{(s)} + \frac{3}{2} \text{O}_{2(g)} \longrightarrow \text{B}_2\text{O}_{3(s)},$$

$$\Delta H_2 = -1273 \text{ KJ mol}^{-1}$$

$$\text{(iii) } 3\text{H}_2\text{O}_{(l)} \longrightarrow 3\text{H}_2\text{O}_{(g)},$$

$$\Delta H_3 = 44 \times 3 = 132 \text{ KJ mol}^{-1}$$

$$\text{(iv) } 3\text{H}_{2(g)} + \frac{3}{2} \text{O}_{2(g)} \longrightarrow 3\text{H}_2\text{O}_{(l)},$$

$$\Delta H_4 = -286 \times 3 = -858 \text{ KJ mol}^{-1}$$

$$\text{Add (i), (ii), (iii) \& (iv)}$$

$$\text{B}_2\text{H}_{6(g)} + 3\text{O}_{2(g)} \longrightarrow \text{B}_2\text{O}_{3(s)} + 3\text{H}_2\text{O}_{(g)}$$

$$\Delta H = -2035 \text{ KJ mol}^{-1}$$

- $$\text{H}_2 \longrightarrow 2\text{H}$$

$$\Delta S = S_p - S_R = 2 \times 114.6 - 130.6 = 98.6 \text{ J}$$

$$\Delta G = \Delta H - T\Delta S$$

$$\Delta H = \Delta G + T\Delta S = 406.62 + \frac{298 \times 98.6}{1000}$$

$$\Delta H = 436 \text{ kJ}$$
- $$\text{H}_2\text{O}(\ell) \rightleftharpoons \text{H}_2\text{O}(\text{g})$$

$$\text{For 1 mole}$$

$$\Delta H_{\text{vap}} = 10 \text{ kCal/mol}$$

$$\Delta H = \Delta U + \Delta n_g RT$$

$$\Delta U = 10 \text{ kCal/mole} - \frac{1 \times 2 \times 500}{1000}$$

$$= 9 \text{ kCal/mole}$$

$$\text{For 3 mole}$$

$$\Delta U = 9 \times 3 \Rightarrow 27 \text{ kCal}$$
- $$S = 1.23 \text{ kJ/gm/K}$$

$$C = MS = 80 \times 1.23 \text{ kJ/mole K.}$$

$$\Delta E = nC \Delta T$$

$$= 1 \times 80 \times 1.23 \times 6.12$$

$$\Rightarrow 602 \text{ kJ/mole}$$
- $$\text{H}_2 + \text{Cl}_2 \longrightarrow 2\text{HCl} \quad \Delta H = -185 \text{ kJ}$$

$$\text{for 3 mole H}_2 \text{ \& 3 mole Cl}_2$$

$$\Delta H = -185 \times 3 = -555 \text{ kJ}$$

$$\Delta U = \Delta H$$
- For solid phase reaction the entropy change can be considered zero, so, for (1) reaction ΔH and ΔG considered similar.
- (I) $\rightarrow$ spontaneous
- (II) molar entropy for $\text{H}_2\text{O}(\ell) \longrightarrow \text{H}_2\text{O}(\text{g})$
- $$S_{\text{H}_2\text{O}(\ell)} < S_{\text{H}_2\text{O}(\text{g})}$$

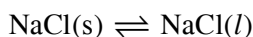
$$\Delta H = \Delta E + \Delta n_g RT$$

$$(\Delta H - \Delta E) = \Delta n_g RT$$

$$\text{NH}_4\text{HS}(\text{s}) \longrightarrow \text{H}_2\text{S}(\text{g}) + \text{NH}_3(\text{g})$$

$$(2 - 0) = \text{Maximum}$$
- As $T \uparrow, S \uparrow$
- At 25°C ; H_2 have more entropy than others.

17. $\Delta G = \Delta H - T\Delta S$



$$\Delta G = 0 \quad (\text{At equilibrium})$$

$$\Delta H = T\Delta S$$

$$T = \frac{\Delta H}{\Delta S} = \frac{30.5 \times 1000}{28.8} \Rightarrow 1059 \text{ K}$$

18. $|w| = nR\Delta T$

$$|w| = 1 \times R \times 1^\circ = R.$$

19. $\Delta_r H = \Sigma(\text{B.E.})_R - \Sigma(\text{B.E.})_P$

20. $\Delta S = nC_V \ln \frac{T_2}{T_1} + nR \ln \frac{V_2}{V_1}$

$$= C_V \ln 2 + R \ln \frac{1}{2}$$

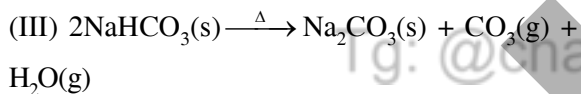
$$= C_V \ln 2 - R \ln 2$$

$$= \ln 2 (C_V - R)$$

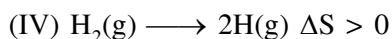
$$= (C_V - R) \ln 2$$

21. (I) Liquid $\longrightarrow$ solid $\Delta S < 0$

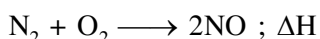
(II) Solid (T_1) $\longrightarrow$ Solid (T_2) $\Delta S > 0$
($T_2 > T_1$)



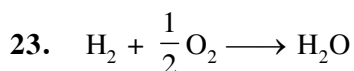
$$\Delta S > 0$$



22. ΔH_f formation of 1 mole compound from its native constituents



$$\Delta H_f = \frac{\Delta H}{2}$$



$$(\text{calorific value} \times M_w) = \Delta H_{\text{comb.}}(\text{H}_2)$$

$$-143 \times 2 = \Delta H_{\text{comb.}}(\text{H}_2)$$

$$-286 \text{ kJ/mole} = \Delta H_{\text{comb.}}(\text{H}_2)$$

$$= \Delta H_f(\text{H}_2\text{O})$$

24. $\Delta H = q_p$

$$\Delta E = q_v$$

$$\Delta H = \Delta E + \Delta n_g RT$$

$$q_p = q_v + \Delta n_g RT$$

$$q_v = q_p - \Delta n_g RT$$

$$= -210 - \frac{(-2) \times 2 \times 298}{1000}$$

$$= -208.8 \text{ kCal/mole}$$

25. due to high hydration of F^-

26. $\Delta H = \Delta U + \Delta(PV)$

$$\Delta H = \Delta U + P_2 V_2 - P_1 V_1$$

We cannot use here $\Delta H = \Delta U + \Delta n_g RT$ since, gases deviates from ideal gas behaviour. Thus,

$$\Delta(PV) = P_2 V_2 - P_1 V_1 = 4 \times 1 - 70 \times 1$$

$$= -30 \text{ litre-atm} = -3.0 \text{ kJ}$$

$$\therefore -560 = \Delta U - 3.0$$

$$\therefore \Delta U = -557 \text{ kJ}$$

28. eq.(2) - eq.(1) = eq.(3)

$$\Delta H = -241.81 - 436$$

$$(\Delta H)_{\text{III}} = -677.81$$

$$\frac{\Delta H_{\text{III}}}{\Delta H_{\text{II}}} = \frac{-677.81}{-241.81} = 2.8$$

29. In an adiabatic process

$$W = \Delta E$$

$$\Rightarrow W = \frac{nR}{\gamma - 1} \times (\Delta T)$$

$$\Rightarrow -250R = \frac{5R}{\gamma - 1} \times (-20)$$

$$\Rightarrow \gamma - 1 = 2/5$$

$$\Rightarrow \gamma = 1 + 2/5 = 7/5$$

REDOX REACTION

1. Law of equivalence

$$\text{Meq of Fe}^{+2} + \text{Meq of C}_2\text{O}_4^{2-} = \text{Meq of Cr}_2\text{O}_7^{2-}$$

$$X + Y = Z$$

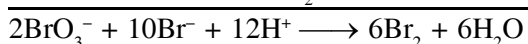
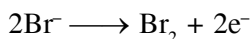
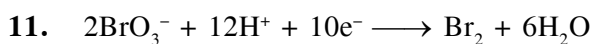
3. $2 \times n = \frac{0.16 \times 35}{1000}$

$$n = \frac{0.08 \times 35}{1000} \Rightarrow 0.0028$$

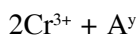
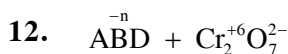
$$\text{wt} = n \times (\text{Mw}) \Rightarrow 0.0028 (55 + 32) \Rightarrow 0.24 \text{ gm}$$

4. $N = \frac{w}{E} \times \frac{1}{V(L)} \Rightarrow 0.05 = \frac{w}{158} \times \frac{1}{4}$

$$w = 6.32 \text{ gm}$$



$$\text{Eq wt.} = \frac{6M}{10} \Rightarrow \frac{3M}{5}$$

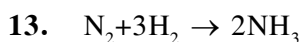


Total oxidation = Total Reduction

$$(3.26 \times 10^{-3}) (y - (-n)) = (1.68 \times 10^{-3}) \times 6$$

$$2 \times y + n = 63$$

$$y = 3 - n$$



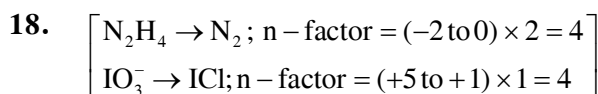
equivalent weight = molecular weight / v.f.

$$y_1 - y_2 = \frac{x_1}{3} - \frac{x_2}{6}$$

$$= \frac{2x_1 - x_2}{6}$$

17. From oxd. No method, we get

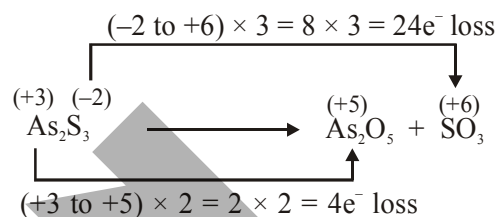
$$x = 2, y = 5, z = 10$$



$$E_{\text{N}_2\text{H}_4} = \frac{32}{4} = 8$$

$$E_{\text{KIO}_3} = \frac{214}{4} = 53.5$$

- 20.



$$\therefore \text{v.f. of As}_2\text{S}_3 = 4 + 24 = 28$$

$$E = \frac{M}{28}$$

BEHAVIOUR OF GASES

$$1. \quad \frac{r_{\text{SO}_2}}{r_{\text{O}_2}} = \frac{20/120}{V_{\text{O}_2}/60} = \sqrt{\frac{32}{64}}$$

$$2. \quad r_x = 0.88 r_{\text{PH}_3}$$

$$\frac{r_x}{r_{\text{PH}_3}} = \sqrt{\frac{M_{\text{PH}_3}}{M_x}} \quad 0.88 = \sqrt{\frac{34}{M_x}}$$

$$M_x = 43.9 \approx 44$$

$$[M_w \text{ of } \text{N}_2\text{O} = 44]$$

$$3. \quad P = CRT$$

$$1 = 2 \times 0.0821 \times T$$

$$[T = 6.1 \text{ K}]$$

$$5. \quad r_A = 5 r_B$$

$$\frac{r_A}{r_B} = 5 = \sqrt{\frac{d_B}{d_A}}$$

$$6. \quad Z = \frac{PV}{RT} = 0.5$$

$$\therefore \frac{100 \times V}{0.082 \times 273} = 0.5$$

$$\therefore V = 0.112 \text{ litre}$$

Now, using van der Waals' equation

$$\left[P + \frac{a}{V^2} \right] [V] = RT$$

$$\text{or } \left[P + \frac{a}{V^2} \right] = \frac{RT}{V} \quad (\because b \text{ is negligible})$$

$$\therefore \left[100 + \frac{a}{(0.112)^2} \right] = \frac{0.082 \times 273}{0.112} = 199.88$$

$$\therefore \frac{a}{(0.112)^2} = 99.88, a = 1.253 \text{ L}^2\text{mol}^{-2}\text{atm}$$

$$7. \quad \frac{r_{\text{CH}_4}}{r_{\text{HBr}}} = \sqrt{\frac{81}{16}} \quad \frac{n_{\text{CH}_4}}{n_{\text{HBr}}} = \frac{9}{4}$$

$$x_{\text{CH}_4} = 0.69$$

$$8. \quad \frac{r_{\text{H}_2}}{r} = \sqrt{\frac{M}{2}} \quad \frac{x/5}{x/t} = \sqrt{\frac{M}{2}} \quad \frac{t}{5} = \sqrt{\frac{M}{2}}$$

Check every option to satisfy the relation option (2) satisfied

$$9. \quad \left(P + \frac{an^2}{V^2} \right) (V - nb) = nRT$$

$$\text{For } n = \frac{1}{2}, \left(P + \frac{a}{4V^2} \right) \left(V - \frac{b}{2} \right) = \frac{1}{2}RT$$

$$\left(P + \frac{a}{4V^2} \right) (2V - b) = RT$$

12. Due to the smallest particle size and the thinnest electron clouds of H_2 & He at $p > 0$ the inter particle repulsion instead of inter particle attraction becomes more effective

$$\therefore \text{from } \left(p + \frac{a}{V^2} \right) (V - b) = RT$$

$$p(V - b) = RT$$

$$pV - p_b = RT$$

13. At constant temperature,

$$P \propto \frac{1}{V}$$

$$\therefore P_3 < P_2 < P_1 \text{ or } P_1 > P_2 > P_3$$

$$16. \quad P_{\text{correction}} = \frac{an^2}{V^2} \quad \text{Unit of } a = \text{atm litre}^2 \text{ mol}^{-2}$$

$$V_{\text{correction}} = nb \quad \text{Unit of } b = \text{litre mol}^{-1}$$

$$\text{Unit of } \left(\frac{a}{b} \right) = \frac{\text{atm litre}^2 \text{ mol}^{-2}}{\text{litre mol}^{-1}} = \text{atm litre mol}^{-1}$$

SOLID STATE

1. For bcc

$$4r = a\sqrt{3}$$

$$r = \frac{a\sqrt{3}}{4} = \frac{350\sqrt{3}}{4} = 151.5 \text{ pm}$$

2. $d = \frac{Z \times M}{N_A \times a^3}$

$$6.25 = \frac{Z \times 120}{6 \times 10^{23} \times (4 \times 10^{-8})^3} \Rightarrow z = 2$$

So crystal lattice is bcc

3. For fcc, $z = 8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4$

$$d = \frac{Z \times M}{N_A \times a^3}$$

$$3.2 = \frac{4 \times M}{6 \times 10^{23} \times (5 \times 10^{-8})^3}$$

$$\begin{aligned} a &= 0.5 \text{ nm} \\ &= 0.5 \times 10^{-9} \text{ m} \\ &= 5.5 \times 10^{-10} \text{ m} \\ &= 5.5 \times 10^{-8} \text{ cm} \end{aligned}$$

$$M = \frac{3.2 \times 6 \times 10^{23} \times 10^{-24} \times 125}{4} \approx 60$$

4. No of moles of element X = $\frac{8}{80} = 0.1 \text{ mol}$

No of atoms of element X = $0.1 N_A$

For fcc' 4 atoms = one unit cell

$$1 \text{ atom} = \frac{1}{4} \text{ unit cell}$$

$$0.1 N_A = \frac{0.1 N_A}{4} \text{ unit cell}$$

5. $O^{2-} \rightarrow \text{ccp} = 8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4$

$$A^{2+} \rightarrow \frac{1}{8} \text{ THV} = \frac{1}{8} \times 8 = 1$$

$$B^{3+} \rightarrow \frac{1}{2} \text{ OHV} = \frac{1}{2} \times 4 = 2$$



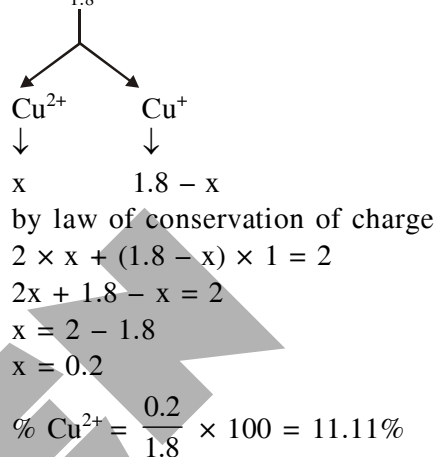
6. In NaCl, Na^+ are present in OHV

So 1st neighbours at $\frac{a}{2}$ distance = $6Cl^-$

IInd nearest neighbours $\left(\frac{a}{\sqrt{2}}\right)$ distance = $12Na^+$

IIIrd nearest neighbours $(0.85a)$ distance = $8Cl^-$

7. $Cu_{1.8}S \rightarrow$ Nonstoichiometric compound



8. $(d)_{fcc} = \frac{4 \times M}{N_A \times a^3}$

$$(d)_{fcc} = \frac{4 \times M}{N_A \times \left(\frac{4r}{\sqrt{2}}\right)^3}$$

$$(d)_{fcc} = \frac{2\sqrt{2} \times 4 \times M}{N_A \times 64r^3} \quad \dots(1)$$

$$(d)_{bcc} = \frac{2 \times M}{N_A \times a^3} = \frac{2 \times M}{N_A \times \left(\frac{4r}{\sqrt{3}}\right)^3}$$

$$(d)_{bcc} = \frac{2 \times M}{N_A \times 64r^3} \times 3\sqrt{3} \quad \dots(4)$$

$$\text{Ratio } \frac{(d)_{fcc}}{(d)_{bcc}} = \frac{2\sqrt{2} \times 4 \times M}{N_A \times 64r^3} \times \frac{N_A \times 64r^3}{2M3\sqrt{3}}$$

$$\frac{(d)_{fcc}}{(d)_{bcc}} = \frac{4\sqrt{2}}{3\sqrt{3}} = \frac{4 \times 1.4}{3 \times 1.7}$$

$$\frac{(d)_{fcc}}{(d)_{bcc}} = \frac{5.6}{5.1}$$

$$\frac{(d)_{bcc}}{(d)_{fcc}} = \frac{5.1}{5.6} = 0.918$$

9. $a = 5 \times 10^{-8} \text{ cm}$

$d = 3.84 \text{ g/cm}^3$

$$3.84 = \frac{Z \times 72}{6 \times 10^{23} \times (5 \times 10^{-8})^3}$$

$$Z = \frac{3.84 \times 6 \times 10^{23} \times 125 \times 10^{-24}}{72} = 4$$

no. of formula units = 4 So
no. of $\text{Fe}^{+2} = 4$, no. of $\text{O}^{2-} = 4$

10. Along body diagonal

2 corner, 1 OHV, 2 THV

2A, C, 2D

11. $X \rightarrow \text{fcc} = 6 \times \frac{1}{8} + 6 \times \frac{1}{2} = \frac{15}{4}$

$Y \rightarrow \text{OHV} = 12 \times \frac{1}{4} = 3$

$Z \rightarrow \text{THV} = 6$

$X_{15/4} Y_3 Z_6$

$X_{15} Y_{12} Z_{24} \Rightarrow X_5 Y_4 Z_8$

13. $\frac{r_{A^+}}{r_{B^-}} = 0.225$ (for THV)

$r_{A^+} = 200 \times 0.225 = 45 \text{ pm}$

14. In a unit cell no. of atoms $= 8 \times \frac{1}{8} + 4 \times 2 = 9$

15. $A \rightarrow 8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4$

$B \rightarrow 4 \times \frac{50}{100} = 2$

$C = 8 \times \frac{50}{100} = 4$

Formula of compound A_2BC_2

16. $\text{O}^{2-} = 12 \times \frac{1}{6} + 2 \times \frac{1}{2} + 3 = 6$

$\text{Al}^{+3} = \frac{2}{3} \times \text{OHV} = \frac{2}{3} \times 6 = 4$

$\text{Al}_4\text{O}_6 \Rightarrow \text{formula}$

Empirical formula = Al_2O_3

17. $A \rightarrow 1$ $B \rightarrow 8 \times \frac{1}{8} = 1$

$C \rightarrow 2 \times \frac{1}{2} = 1$

Empirical Formula $\Rightarrow \text{ABC}$

18. $A \rightarrow 7 \times \frac{1}{8} = \frac{7}{8}$ $B \rightarrow 6 \times \frac{1}{2} = 3$

$A_{7/8} B_3 \Rightarrow A_7 B_{24}$

19. $A \rightarrow 8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4$

$B \rightarrow 8 = 8 = N$

no. of A atoms = $\frac{N}{2} = 4$

20. $\text{O}^{2-} \rightarrow 8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4$

$A \rightarrow \frac{1}{6} \times 8 = \frac{4}{3}$

$B \rightarrow \frac{1}{3} \times 4 = \frac{4}{3}$

Empirical formula = $A_{4/3} B_{4/3} O_4 \Rightarrow \text{ABO}_3$

21. A $\rightarrow$ lattice point

B $\rightarrow$ all the THV

C.N. = 8, 4

22. 4, 4

23. no. of moles of NaCl = $\frac{10}{58.5}$

no. of formula units = $\frac{10}{58.5} \times N_A$

4 formula units of NaCl = 1 unit cell $\frac{10N_A}{58.5}$

formula units of NaCl = $\frac{1}{4} \times \frac{10N_A}{58.5} = \frac{2.5N_A}{58.5}$

24. A^+ B^-

$4 \times \frac{1}{8} + 4 \times \frac{1}{2}$ $10 \times \frac{1}{4}$

$\frac{1}{2} + 2$ 2.5

2.5

A B

CHEMICAL KINETICS



$$\Delta H = E_{a,f} - E_{a,b}$$

$$72 = 77 - E_{a,b}$$

$$E_{a,b} = 77 - 72 = 5 \text{ kJ}$$

2. $r_1 = K_1 C_{A_0}$ For first order

$r_0 = k_0$ For zero order

$$\frac{r_1}{r_0} = \frac{K_1 C_{A_0}}{k_0} \quad t_{1/2,1} = t_{1/2, \text{Zero}}$$

$$\frac{0.693}{K_1} = \frac{C_{A_0}}{2K_0}$$

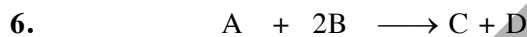
$$\frac{r_1}{r_0} = 2 \times 0.693$$

3. $K_1 = \frac{2.303}{t} \log \frac{100}{10}; \quad K_2 = \frac{2.303}{2t} \log \frac{100}{1}$

$$\frac{K_1}{K_2} = \frac{2 \log 10}{\log 100} = 1$$

4. $[A]_t = A_0 e^{-kt}$

$$[A]_t = A_0 e^{-1} = \frac{[A]_0}{e}$$



initially 0.6 0.8

At time t 0.6 - x 0.8 - 2x x x

given x = 0.2

At time t $P_A = 0.6 - 0.2 = 0.4$

$P_B = 0.8 - 0.4 = 0.4$

$$r_{\text{initial}} = k[P_A][P_B]^2$$

$$r_t = k[P_A][P_B]^2$$

$$\frac{r_t}{r_{\text{initial}}} = \frac{k[0.4][0.4]^2}{k[0.6][0.8]^2} = \frac{0.4 \times 0.4 \times 0.4}{0.6 \times 0.8 \times 0.8} = \frac{1}{6}$$

7. It is zero order reaction

$$x = kt$$

$$x = 1.2 \times 10^{-2} \times (10 \times 60)$$

$$x = 7.2 \text{ M}$$

8. Apply formula

$$\text{Remaining conc}^n = \text{initial conc}^n \left(\frac{1}{2} \right)^{\text{No. of half lives}}$$

$$\text{from given condition } [A] \left[\frac{1}{2} \right]^{1/5} = \frac{[A]}{4} \left[\frac{1}{2} \right]^{1/15}$$

on solving for t, $t = 15 \text{ min}$

9.
$$e^{-E_a/RT} = \left[\frac{e^{-E_{a1}/RT} \times e^{-E_{a2}/RT}}{e^{-E_{a3}/RT}} \right]^{2/3}$$

$$E_a = \frac{2}{3} [E_{a1} + E_{a2} - E_{a3}]$$

$$= \frac{2}{3} [180 + 80 - 50] = 140 \text{ kJ/mol}$$

10. $K_{27^\circ\text{C}} = \frac{2.303}{20} \times \log \frac{100}{50} = \frac{2.303}{20} \log 2$

$$K_{47^\circ\text{C}} = \frac{2.303}{5} \times \log \frac{100}{50} = \frac{2.303}{5} \log 2$$

$$\log \frac{K_{27^\circ\text{C}}}{K_{47^\circ\text{C}}} = \frac{E_a}{2.303R} \left[\frac{1}{320} - \frac{1}{300} \right]$$

$$\log \frac{1}{4} = \frac{E_a}{2.303 \times 8.314} \times \frac{-20}{320 \times 300}$$

$$E_a = \frac{0.6 \times 320 \times 300 \times 2.303 \times 8.314}{20 \times 1000}$$

$$= 55.14 \text{ kJ/mol}$$

11. $K_1 = \frac{0.693}{40} = \frac{0.693}{40}$

$$K_0 = \frac{1.386}{2 \times 20} = \frac{0.693}{20}$$

$$\frac{K_1}{K_0} = \frac{1}{2} = 0.5 \text{ mol}^{-1} \text{ dm}^3$$

12. $\frac{k_{T_2}}{k_{T_1}} = (\mu)^{\Delta T/10}$

$$\frac{10^{-3}}{k_{T_1}} = (\mu)^{20/10} = 4$$

$$k_{T_1} = \frac{10^{-3}}{4}$$

$$= 2.5 \times 10^{-4} \text{ min}^{-1}$$

13. From first experiment

$$0.1 = K[1] [0.2]^2$$

$$K = 2.5$$

$$r = 2.5[2] [0.6]^2 \text{ In exp. II} \\ = 1.8 \text{ M s}^{-1}$$

14. $\frac{K}{A} = e^{-\frac{E_a}{RT}} = \frac{0.0001}{100}$

$$-\frac{E_a}{RT} = 2.303 \log 10^{-6}$$

$$E_a = 2 \times 400 \times 2.303 \times 6 \\ = 11.05 \text{ k Cal/mol}$$

15. $\therefore K = \frac{2.303}{t} \log \left(\frac{V_\infty}{V_\infty - V_t} \right)$

V_∞ = vol. of gas collected at the end of reaction

V_t = vol. of gas collected at any time 't'

at $t = 20$ min.

$$K = \frac{2.303}{20} \log \left(\frac{10}{10-5} \right) = \frac{2.303}{20} \log 2 \dots (1)$$

at $t = 10$ min.

$$K = \frac{2.303}{40} \log_{10} \left(\frac{10}{10-V_t} \right) \dots (2)$$

from (1) & (2)

$$\frac{2.303}{20} \log 2 = \frac{2.303}{40} \log \left(\frac{10}{10-V_t} \right)$$

$$2 \log 2 = \log \left(\frac{10}{10-V_t} \right)$$

$$\log 2^2 = \log \left(\frac{10}{10-V_t} \right) \therefore \frac{10}{10-V_t} = 4$$

$$V_t = 7.5 \text{ mL}$$

16. $(t_{1/2})_1 = \frac{0.693}{K_1} \quad (t_{1/2})_2 = \frac{0.693}{K_2}$

$$\frac{(t_{1/2})_1}{(t_{1/2})_2} = \frac{K_2}{K_1} \quad \frac{3}{2} = \frac{K_2}{K_1}$$

$$K_1(t)_{25\%} = 2.303 \log \frac{100}{75} \\ = 2.303 \times 0.1249 \dots (1)$$

$$K_2(t)_{75\%} = 2.303 \log \frac{100}{25} \\ = 2.303 \times 0.602 \dots (2)$$

From equation (2) / (1)

$$\frac{K_2(t)_{75\%}}{K_1(t)_{25\%}} = \frac{2.303 \times 0.602}{2.303 \times 0.1249}$$

$$\frac{3}{2} \times \left(\frac{t_{75\%}}{t_{25\%}} \right) = \frac{0.602}{0.1249}$$

$$\frac{t_{25\%}}{t_{75\%}} = \frac{3}{2} \times \frac{0.1249}{0.602} \left[\frac{t_{25\%}}{t_{75\%}} = \frac{0.311}{1} \right]$$

17. $C^{(1-n)} - C_0^{(1-n)} = (n-1) kt$

put $n = 3 \quad C^{-2} - C_0^{-2} = 2 kt$

concentration i.e. = $\frac{\text{mol}}{\ell}$

$$\left(\frac{\text{mol}}{\ell} \right)^{-2} = K \times \text{second}$$

$$k = \ell^2 \text{ mol}^{-2} \text{ sec}^{-1}$$

18. $t_{1/2} = \frac{0.693}{K} \quad 60 = \frac{0.693}{K}$

$$K = \frac{0.693}{60} \text{ min}^{-1} \quad Kt = 2.303 \log \frac{a_0}{a_0-x}$$

$$\frac{0.693}{60} \times t = 2.303 \log \frac{8}{7}$$

$$t = 11.56 \text{ minutes}$$

19. Given $t_{67\%} - t_{33\%} = 30$

$$\left(\frac{2.303}{k} \log \frac{a}{a/3} \right) - \left(\frac{2.303}{k} \log \frac{a}{2a/3} \right) = 30$$

$$\frac{2.303}{k} [\log 3 - \log 3 + \log 2] = 30$$

$$k = \frac{2.303 \times 0.3}{30} = \frac{2.303}{100}$$

$$t_{25\%} = \frac{2.303}{2.303} \times 100 \log \frac{a}{3a/4}$$

$$t_{25\%} = 100 \times \log \frac{4}{3} \\ = 100 \times 0.123 = 12.3 \text{ min.}$$

20. $A(g) \longrightarrow 2B(g) + C(g)$

Initial pressure : $0.5 \quad 0 \quad 0$

Pressure after 2 hrs.: $0.5 - p \quad 2p \quad p$

Total pressure after 2 hours = $0.5 - p + 2p + p = 0.5 + 2p$

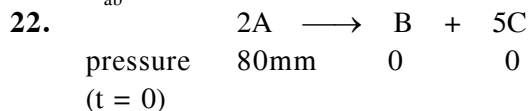
Given that : $0.5 + 2p = 0.7$ or $p = 0.1$

Pressure of A after 2 hours = $0.5 - p = 0.5 - 0.1 = 0.4$

Units of rate constant suggest that it is a first order reaction.

Rate of reaction after 2 hours = $k[A]$
 $= 10^{-3} \times 0.4 = 4 \times 10^{-4} \text{ atm s}^{-1}$

21. $E_{af} - E_{ab} = \Delta H$
 $70 - E_{ab} = -22$
 $E_{ab} = 92 \text{ kCal}$



At 't' $(80-x) \quad \frac{x}{2} \quad \frac{5x}{2}$

$\Rightarrow P_{\text{total}} = (80-x) + \frac{x}{2} + \frac{5x}{2} = 100 \text{ mm}$

$x = 10 \text{ mm}$

$(\Delta p)_{A_2} = x = 10$

$r_{A_2} = \left| \frac{\Delta p}{\Delta t} \right| = \frac{10}{5} = 2 \text{ mm min}^{-1}$

23. According to Arrhenius equation,

$k = A \cdot e^{-E_a/RT}$ (Catalyst absent)

$k' = A \cdot e^{-E'_a/RT}$ (Catalyst present)

Given $E'_a = 4.15 \text{ kJ mol}^{-1}$

$\therefore \frac{k'}{k} = e^{(E_a - E'_a)/RT}$

Given $k' = 2.718k = ek$

Hence $e = e^{(E_a - E'_a)/RT}$

or $\frac{E_a - E'_a}{RT} = 1$

or $E_a = E'_a + RT$
 $= 4.15 + 8.3 \times 500 \times 10^{-3}$
 $= 8.3 \text{ kJ mol}^{-1}$

24. $K = \frac{2.303}{60} \times \log \left(\frac{2M}{0.125M} \right)$

$K = \frac{2.303}{(1 \text{ hr} = 60 \text{ min})} \times (\log 16 = 4 \log 2)$

$K = \frac{2.303 \times \log 2}{15} = \frac{0.693}{15} \text{ min}^{-1}$

$\therefore t_{1/2} = \frac{0.693}{K} = 15 \text{ min}$

SOLUTION AND COLLIGATIVE PROPERTIES

1. $\text{molality} = \frac{n}{w_g} \times 1000$

$$\text{molality} = \frac{n}{500} \times 1000 = 2n$$

$$\Delta T_b = T_b - T_b^0$$

$$\Delta T_f = T_f^0 - T_f$$

$$\Delta T_b + \Delta T_f = (T_b - T_b^0) + (T_f^0 - T_f)$$

$$(K_b \times m + K_f \times m) = 103.57 + (0 - 100)$$

$$(0.52 + 1.86) \times 2n = 3.57$$

$$n = \frac{3.57}{2 \times 2.38} = \frac{357}{2 \times 238} \text{ mol}$$

$$\text{no. of millimol} = \frac{357 \times 1000}{2 \times 238} = 750 \text{ millimol}$$

2. $(\Delta T_f)_I = K_f \times m$

$$0.2 = 1.86 \times \frac{x}{100} \times 1000$$

$$x = \frac{0.2}{1.86 \times 10} = \frac{2}{186} \text{ mol}$$

$$(\Delta T_f)_{II} = 1.86 \times \frac{2 \times 1000}{186 \times W}$$

$$0.25 = 1.86 \times \frac{2 \times 1000}{186 \times W} \Rightarrow W = \frac{2 \times 1000}{25}$$

$$W = 80 \text{ g}$$

$$\text{Amount of ice separated out} = 100 - 80 = 20 \text{ g}$$

3. Higher is $(i \times c)$; higher will be ΔT_f . So, lower will be T_f

$$i \times c \text{ for } \text{KNO}_3 = 2 \times 0.05 = 0.1$$

$$\text{BaCl}_2 = 3 \times 0.04 = 0.12$$

$$\text{Sucrose} = 1 \times 0.140 = 0.14$$

$$\text{CuSO}_4 = 2 \times 0.075 = 0.15$$

4. $i = 1 + 2\alpha$

$$1.98 = 1 + 2\alpha$$

$$2\alpha = 0.98$$

$$\alpha = 0.49$$

$$\% \alpha = 49 \%$$

5. $N = \frac{x}{5.6}$; x is volume strength of H_2O_2

$$\frac{6.8 \times 1000}{17 \times 2240} = \frac{x}{5.6}$$

$$\frac{400}{224} = \frac{x}{5.6}$$

$$x = \frac{400}{224} \times 5.6 = 10$$

6. $m \propto P$ so, $\frac{m_1}{m_2} = \frac{P_1}{P_2}$

$$\frac{4 \times 10^{-3}}{m_2} = \frac{100}{250}$$

$$m_2 = \frac{25 \times 4 \times 10^{-3}}{10} = 10^{-2} \text{ kg L}^{-1}$$

$$1 \text{ L solution contains} = 10^{-2} \text{ kg gas}$$

$$0.25 \text{ L solution contains} = 0.25 \times 10^{-2} \text{ kg} = 2.5 \times 10^{-3} \text{ kg}$$

7. For S_1 ; $i_1 \times C_1 = 2 \times 0.1 = 0.2 \rightarrow \text{Hypertonic}$

$$\text{For } S_2; i_2 \times C_2 = 2 \times 0.05 = 0.15 \rightarrow \text{Hypotonic}$$

8. $\text{Molarity} = \frac{\text{total moles}}{\text{total vol}} = \frac{36}{2} \times \frac{50}{100} = 9\text{M}$

9. $\text{Molality} = \frac{18 \times 1000}{60 \times (1578 - 60)}$

$$\text{Molality} = \frac{18 \times 1000}{60 \times 1518} = 0.197\text{m}$$

10. $\uparrow i \times c \quad \uparrow \Delta T_b, \quad \uparrow T_b$

$$1\% \text{ glucose} = (i \times c) = \frac{1 \times 1}{180 \times 0.1} = \frac{1}{18} = 0.0555$$

$$1\% \text{ sucrose} = (i \times c) = \frac{1}{342} \times \frac{1}{0.1} = \frac{10}{342} = 0.029$$

$$1\% \text{ NaCl in } \text{H}_2\text{O} = (i \times c) = \frac{1}{58.5} \times \frac{1}{0.1} \times 2 = 0.34$$

$$1\% \text{ CaCl}_2 = (i \times c) = \frac{1 \times 3}{111 \times 0.1} = 0.27$$

$$11. \quad P_S = P_A^0 x_A + P_B^0 x_B$$

$$= P_A^0 \cdot x_A + P_B^0 (1 - x_A)$$

$$P_S = (P_A^0 - P_B^0) x_A + P_B^0 \quad \dots (i)$$

$$P = 120 x_A + 138 \quad \dots (ii)$$

Equating (1) & (ii)

$$P_A^0 - P_B^0 = 120, \quad P_B^0 = 138 \text{ mm of Hg}$$

$$P_A^0 = 120 + 138$$

$$= 258 \text{ mm of Hg}$$

From equation

When $x_A = 0$

$$x_B = 1$$

$$\lim_{x_A \rightarrow 0} \frac{P_B}{x_B} = \boxed{P_B^0 = 138}$$

$$\lim_{x_B \rightarrow 0} \frac{P_A}{x_A} = \boxed{P_A^0 = 258 \text{ mm of Hg}}$$

$$12. \quad \frac{P_B^0 - P}{P_B^0} = x_{\text{solute}}$$

$$\frac{P_B^0 - 0.95P_B^0}{P_B^0} = x_{\text{solute}}$$

$$x_{\text{solute}} = 0.05$$

$$x_{\text{solvent}} = 0.95$$

$$\frac{n_A}{n_B} = \frac{x_A}{x_B} = \frac{5}{95}$$

$$\frac{w_A}{m_A} \times \frac{m_B}{w_B} = \frac{1}{19}$$

$$\frac{w_A}{w_B} = \frac{1}{19} \times \frac{m_A}{m_B} = \frac{1}{19} \times \frac{m_A}{0.3m_A} = \frac{1}{5.7}$$

$$\text{Hence } \frac{w_B}{w_A} = 5.7$$

$$13. \quad \text{Molecular mass} = 12 \times 11 + 8 + 32$$

$$\text{of naphthoic acid} = 132 + 40$$

$$= 172$$

$$\Delta T_f = i \times K_f \times m$$

$$2 = i \times 1.72 \times \frac{20 \times 1000}{172 \times 50}$$

$$2 = i \times \frac{20}{5}$$

$$i = \frac{2}{4} = 0.5$$

$$14. \quad \frac{P_A^0}{P_B^0} = \frac{1}{2}, \quad \frac{x_A}{x_B} = \frac{1}{2}$$

$$y_A = \frac{P_A^0 \cdot x_A}{P_A^0 x_A + P_B^0 x_B} = \frac{\frac{P_B^0}{2} \times \frac{x_B}{2}}{\frac{P_B^0 x_B}{4} + P_B^0 x_B}$$

$$y_A = \frac{P_B^0 x_B}{5 P_B^0 x_B} = \frac{1}{5}$$

$$y_A = 0.2$$

$$15. \quad \frac{P_B^0 - \frac{4}{5} P_B^0}{P_B^0} = \frac{n_A}{n_A + 10}$$

$$\frac{1}{5} = \frac{n_A}{n_A + 10}$$

$$n_A + 10 = 5n_A$$

$$4n_A = 10$$

$$n_A = \frac{10}{4} = 2.5$$

$$\frac{w_A}{40} = 2.5$$

$$w_A = 40 \times 2.5 = 100 \text{ g}$$

$$16. \quad \text{Mass of } C_2H_5OH = 150 \times 0.78 \text{ g}$$

$$\text{Volume of water added} = 1000 - 150 = 850 \text{ mL}$$

$$\text{Mass of Water} = 850 \text{ g} = 0.85 \text{ kg}$$

$$\text{Molality} = \frac{150 \times 0.78}{46 \times 0.85} = 2.99 \text{ m}$$

$$17. \quad P_S = P_A^0 \cdot x_A + P_B^0 \cdot x_B$$

$$SP = P_A^0 \times 0.2 + 0.8 \times P_B^0$$

$$SP = SR + SQ$$

$$18. \quad [H^+] = 10^{-2} = C \alpha$$

$$\alpha = \frac{10^{-2}}{C} = \frac{10^{-2}}{0.1} = 10^{-1}$$

$$i = 1 + \alpha$$

$$= 1 + 0.1 = 1.1$$

$$P = i \times CRT$$

$$= 1.1 \times 0.1 \text{ RT}$$

$$= 0.11 \text{ RT}$$

$$19. (\Delta T_b)_I = K_b \times \frac{0.1}{m_p \times 100} \times 1000 \quad \dots (i)$$

$$(\Delta T_b)_{II} = K_b \times \frac{0.1}{m_Q \times 100} \times 1000 \quad \dots (ii)$$

I/II

$$\frac{(\Delta T_b)_I}{(\Delta T_b)_{II}} = \frac{M_Q}{M_P}$$

$$\frac{0.2}{0.4} = \frac{M_Q}{M_P} \quad \boxed{\frac{M_P}{M_Q} = \frac{2}{1}}$$

$$\begin{aligned} 20. \pi &= \pi_1 + \pi_2 \\ &= C_1 RT_1 + C_2 RT_2 \\ &= \left(\frac{0.6 \times 3}{60 \times 0.6} + \frac{3.42 \times 3}{342 \times 0.6} \right) RT = \left(\frac{1}{6} + \frac{1}{20} \right) RT \\ &= \left(\frac{1}{10} \right) \times 0.082 \times 293 \end{aligned}$$

$$P = 2.4 \text{ atm}$$

$$\begin{aligned} 21. M_{\text{final}} &= \frac{480 \times 1.5 + 520 \times 1.2}{1000} \\ &= \frac{720 + 624}{1000} = 1.344 \text{ M} \end{aligned}$$

$$22. \text{RLVP} = X_{\text{solute}} \approx \frac{n_{(\text{solute})}}{n_{(\text{solvent})}} \propto \text{MM}_{(\text{solvent})}$$

(For the same amount of the same solute in same amount of solvent)

$$\therefore \frac{\text{RLVP}_{(A)}}{\text{RLVP}_{(B)}} = \frac{\text{MM}_{(A)}}{\text{MM}_{(B)}} \Rightarrow \frac{2}{1} = \frac{M_A}{M_B}$$

$$\Rightarrow M_A = 2 \times M_B$$

$$24. \pi = \frac{n}{V} \times RT \Rightarrow \pi = \frac{W}{M} \times \frac{RT}{V} = \frac{CRT}{M}$$

(C $\Rightarrow$ in g/L)

$$\therefore \log \pi = \log C + \log \left(\frac{RT}{M} \right)$$

$$\text{Thus } \text{OA} = \log(x \times 10^{-2}) = \log \left(\frac{RT}{M} \right)$$

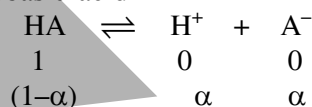
$$\Rightarrow x \times 10^{-2} = \frac{RT}{M}$$

$$\Rightarrow x \times 10^{-2} = 0.0821 \times \frac{300}{300}$$

$$\Rightarrow x \times 10^{-2} = 8.21 \times 10^{-2}$$

$$\Rightarrow x = 8.21$$

25. For monobasic acid HA



From Ostwald dilution law,

$$K_a = \frac{C\alpha^2}{(1-\alpha)}$$

$$\text{Now, } \Delta T_{\text{nor}} = K'_f \times \text{molality} = 1.86 \times 0.025 = 0.0465$$

$$\therefore i = \frac{\text{Observed } \Delta T}{\text{Calculated } \Delta T} = 1 + \alpha$$

$$i = \frac{0.06}{0.0465} = 1 + \alpha$$

$$\therefore \alpha = 0.29 \text{ and } C = 0.025 \text{ M}$$

$\therefore$ By Eq. (1),

$$K_a = \frac{0.025 \times (0.29)^2}{(1-0.29)} = 2.96 \times 10^{-3}$$

ELECTROCHEMISTRY

1. Initial equivalent of $\text{Cr}^{+3} = M \times V \times V.F.$

$$\Rightarrow 0.2 \times \frac{250}{1000} \times 3 \Rightarrow 0.15$$

Final equivalent of

$$\text{Cr}^{+3} = 0.1 \times \frac{250}{1000} \times 3 \Rightarrow 0.075$$

Left equivalent of $\text{Cr}^{+3} = 0.15 - 0.075 \Rightarrow 0.075$

$$w = \frac{\text{equivalent weight} \times I \times t}{96500}$$

$$0.075 = \frac{96.5 \times t}{96500}$$

$$t = 75 \text{ sec.}$$

2. $\text{NaCl} + 4\text{H}_2\text{O} \longrightarrow \text{NaClO}_4 + 4\text{H}_2$
 $\begin{matrix} -1 & +7 \end{matrix}$

Change in oxidation no. of NaClO_4 (V.F.) = 8

Molecular wt. of $\text{NaClO}_4 = 122.5 \text{ g/mole}$

$$\text{Mol of NaClO}_4 = \frac{1000}{122.5} = 8.16$$

$$\text{No. of Faradays} = 8.16 \times 8 \Rightarrow 65.3 \approx 66$$

5. % efficiency of a cell = $\frac{\Delta G}{\Delta H} \times 100$

$$84 = \frac{-nFE_{\text{cell}}}{\Delta H} \times 100$$

$$84 = \frac{-2 \times 96500 \times E_{\text{cell}}}{-285 \times 10^3} \times 100$$

$$E_{\text{cell}} = 1.24 \text{ volt}$$

6. $\text{H}^+ + \text{e}^- \longrightarrow \frac{1}{2}\text{H}_2(\text{g}) (1 \text{ atm})$

At 1 atm pressure

$$E_{\text{red}} = E_{\text{red}}^{\circ} - \frac{0.0591}{1} \log \frac{(1)^{1/2}}{1}$$

$$E_{\text{red}} = E_{\text{red}}^{\circ} = 0$$

At 100 atm pressure

$$E_{\text{red}}^1 = E_{\text{red}}^0 - \frac{0.0591}{1} \log \frac{(100)^{1/2}}{1}$$

$$E_{\text{red}}^1 = E_{\text{red}}^0 - 0.0591$$

$$E_{\text{red}}^1 = 0 - 0.0591 \Rightarrow -0.0591$$

7. $\text{Mg}(\text{s}) + 2\text{Ag}^+(\text{aq}) \rightleftharpoons \text{Mg}^{+2}(\text{aq}) + 2\text{Ag}(\text{s})$

$$E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{0.0591}{n} \log \frac{[\text{Mg}^{+2}]}{[\text{Ag}^+]^2}$$

$$E_{\text{cell}} = 3.17 - \frac{0.0591}{2} \log \frac{(2 \times 10^{-2})}{(10^{-3})^2}$$

$$E_{\text{cell}} = 3.17 - \frac{0.0591}{2} \times 4.3$$

$$= 3.17 - 0.129$$

$$= 3.04 \text{ volt}$$

$$\Delta G^{\circ} = -nF E_{\text{cell}}^{\circ}$$

$$= -2 \times 96500 \times 3.17$$

$$= -611.8 \text{ kJ}$$

$$Q = \frac{[\text{Mg}^{2+}]}{[\text{Ag}^+]^2} = 20000$$

$$Q = 20000$$

8. $\text{Cu}^{+2} + 2\text{e}^- \longrightarrow \text{Cu}$

$$E_{\text{red}} = E_{\text{red}}^{\circ} - \frac{0.0591}{2} \log \frac{1}{[\text{Cu}^{+2}]}$$

on increasing $[\text{Cu}^{+2}] \uparrow E_{\text{red}} \uparrow$

therefore order of S.R.P. $Q > R > S > P$

10. $W = \frac{\text{eq.wt.} \times Q}{96500}$

$$(a \times b \times c) \times d = \frac{\text{eq.wt.} \times Q}{96500}$$

$$(\text{Area} \times \text{Thickness}) \times d$$

$$(10 \times 10 \times 10^{-2}) \times 8.94 = \frac{31.7 \times Q}{96500}$$

$$Q = \frac{8.94 \times 96500}{31.7} \Rightarrow 27172 \text{ C}$$

12. diameter = $2r$

$$r = \frac{1}{2} \Rightarrow 0.5 \text{ cm}$$

$$\text{Area (A)} = \pi r^2$$

$$\Rightarrow 3.14 \times (0.5)^2$$

$$\Rightarrow 0.785 \text{ cm}^2$$

$$\text{Molar conductivity } (\Lambda_m) = \frac{\kappa \times 1000}{M}$$

$$(\Lambda_m) = \frac{\left(\frac{\ell}{A} \times \frac{1}{R} \right) \times 1000}{M} = \frac{50}{0.785} \times \frac{1}{5.55 \times 10^3} \times 1000$$

$$\Rightarrow 229.65 \text{ cm}^2 \text{ mol eq}^{-1}$$

13. According to nernst equation

$$E_{\text{cell}} = E_{\text{cell}}^{\circ} = \frac{0.0591}{n} \log \frac{(Mg^{+2})}{(Ag^{+})^2}$$

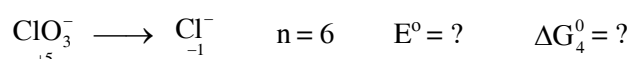
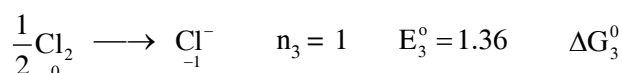
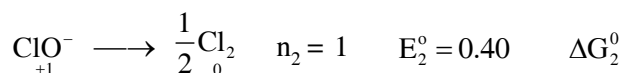
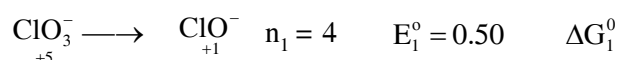
$$E_{\text{cell}} = 3.17 - \frac{0.0591}{2} \log \frac{(0.120)}{(10^{-4})^2}$$

$$E_{\text{cell}} = 2.96 \text{ volt}$$

14. e.m.f. of cell will not be zero because acetic acid is weak electrolyte (Acid) which is not completely ionised.

15. Stronger is reductant. weaker is its conjugate oxidant and vice-versa.

16.



$$\Delta G^{\circ} = \Delta G_1^{\circ} + \Delta G_2^{\circ} + \Delta G_3^{\circ}$$

$$nE^{\circ} = n_1E_1^{\circ} + n_2E_2^{\circ} + n_3E_3^{\circ}$$

$$E^{\circ} = \frac{4 \times 0.50 + 1 \times 0.40 + 1 \times 1.36}{6} \Rightarrow 0.63 \text{ volt}$$

17. If same quantity of electricity is passed then equivalent of Cu^{+2} = equivalent of Cu^{+}

$$\left(\frac{W}{\text{eq.wt}} \right)_{\text{Cu}^{+2}} = \left(\frac{W}{\text{eq.wt}} \right)_{\text{Cu}^{+}}$$

$$\frac{W_{\text{Cu}^{+2}}}{\text{At.wt.}/2} = \frac{W_{\text{Cu}^{+}}}{\text{At.wt.}/1}$$

$$\frac{W_{\text{Cu}^{+2}}}{W_{\text{Cu}^{+}}} = \frac{1}{2}$$

$$18. \Lambda_M^{\infty} = \frac{k \times 1000}{M} \Rightarrow \frac{4.95 \times 10^{-5} \times 1000}{99 \times 10^{-5}} = 50$$

$$\Rightarrow \alpha = \frac{\Lambda_c}{\Lambda_{\infty}} = \frac{50}{400} = 0.125$$

19. According to debye huckel onsagar equation

$$\Lambda_c = \Lambda_{\infty} - b\sqrt{C}$$

$$260 = \Lambda_{\infty} - b\sqrt{0.25} \quad \dots(1)$$

$$250 = \Lambda_{\infty} - b\sqrt{1} \quad \dots(2)$$

$$\text{eq}^n(1) - \text{eq}^n(2)$$

$$\text{than } 10 = 0.5b$$

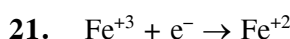
$$b = 20$$

on putting value in eqⁿ(1)

$$260 = \Lambda_{\infty} - 20 \times 0.5$$

$$\Lambda_{\infty} = 270$$

20. Oxidising power $\propto$ SRP



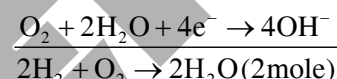
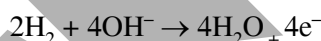
According to nernst eqⁿ

$$E_{\text{red}} = E_{\text{red}}^{\circ} - \frac{0.0591}{1} \log \frac{[\text{Fe}^{+2}]}{[\text{Fe}^{+3}]}$$

$$E_{\text{red}} = 0.770 - 0.0591 \log \frac{1.5}{0.015}$$

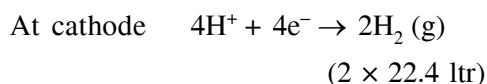
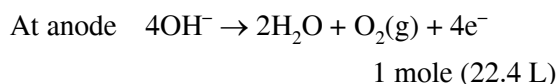
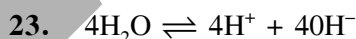
$$E_{\text{red}} = 0.77 - 0.12 \Rightarrow 0.652$$

22. For $\text{H}_2 - \text{O}_2$ Fuel cell



required no. of faraday for two mole $\text{H}_2\text{O} = 4$

required no. of faraday for one mole $\text{H}_2\text{O} = 2$



$$\text{total volume of the gas} = V_{\text{O}_2} + V_{\text{H}_2}$$

$$= 67.2 \text{ ltr.}$$

24. Given $K_a = 25 \times 10^{-6}$

$$M = C = 0.01$$

$$\Lambda_c = 19.6 \text{ S.cm}^2 \text{eq}^{-1}$$

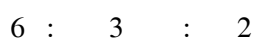
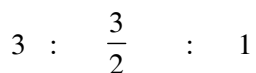
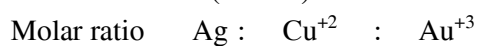
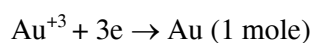
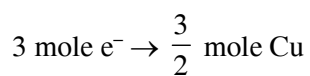
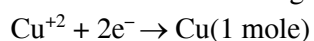
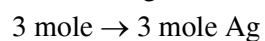
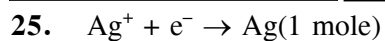
for weak acid

$$K_a = c\alpha^2 \text{ but } \alpha = \frac{\Lambda_c}{\Lambda_{\infty}}$$

$$\alpha = \sqrt{\frac{K_a}{C}} \quad \sqrt{\frac{K_a}{C}} = \frac{\Lambda_c}{\Lambda_{\infty}}$$

$$\sqrt{\frac{25 \times 10^{-6}}{0.01}} = \frac{19.6}{\Lambda_{\infty}}$$

$$\Lambda_{\infty} = 392 \text{ S cm}^2 \text{eq}^{-1}$$



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SURFACE CHEMISTRY

- a, c, d are correct
- Higher will be coagulation power when coagulation value is low
- Slope = $m = \tan 45^\circ = \frac{1}{n}$
 $n = 1$
 $\log \frac{x}{m} = \log k + \left(\frac{1}{n}\right) \log P$
 Intercept = $\log k = 0.30$
 So; $k = 10^{0.30} = 2$
 $\frac{x}{m} = k P^{\frac{1}{n}}$
 $\frac{x}{m} = 2 \times (0.3)$
 $\frac{x}{m} = 0.6$
- Water glass
- Coagulation power $\propto \frac{1}{\text{Coagulation value}}$
 $\frac{\text{AlCl}_3}{\text{NaCl}} = \frac{52}{0.093} = 560$
- Brownian movement is more pronounced for smaller particle than bigger particle.
- $\uparrow$ will be valency of (-)ve charge
 $\uparrow$ coagulation power but
 $\downarrow$ coagulation value
- Associated colloids lowers surface tension but increases viscosity of H_2O
- Below CMC salts behaves as strong electrolyte.
- $\text{AgNO}_3 + \text{KI} \longrightarrow [\text{AgI}] \text{I}^- ; \text{K}^+$
 (excess)
 $\text{AgNO}_3 + \text{KI} \longrightarrow [\text{AgI}]\text{Ag}^+ ; \text{NO}_3^-$
 (excess)
 Both colloids have opposite charge so they coagulate with each other.
- Gold no = $10 \times \frac{\text{mass of lyophilic sol (mg)}}{\text{volume of lyophobic sol (mL)}}$
 $= 10 \times 0.00015 \times 1000 / 10 = 0.15$

- Soaps are emulsifier for oils & grease, which is absorbed on hydrophobic centres of soap, micelles
- $\uparrow T_c, \uparrow$ rate of adsorption.
 $\text{SO}_2 > \text{CO}_2 > \text{H}_2$.
- $\frac{x}{m} = KP^{1/n} \quad 0 \leq \frac{1}{n} \leq 1$
 taking log on both side.
 $\log \frac{x}{m} = \log K + \frac{1}{n} \log P; 0 \leq \frac{1}{n} \leq 1$
- Lyophilic sols are protective colloids because They stabilize lyophobic sols.
- 10 mL Au Sol, 1 mL of 10% NaCl
- $\text{Fe}(\text{OH})_3$ Sol is (+) vely charged
 So $\uparrow$ valency $\downarrow$ (-)ve charge $\downarrow$ will be coagulating power $\therefore \text{PO}_4^{3-}$
- Blue colour of sky is due to scattering of light.
- Smoke precipitator works on the principle of neutralization of charge on colloids.
- $\downarrow$ Will be activation energy $\uparrow$ will be rate.
- Vander walls's force
- Silica gel adsorbs moisture.
- Mo is promoter
- Tyndall effect and less colligative properties are shown by colloidal solution.
- Fact basis
- Fact basis, electrodialysis.
- Colloidal sol is $[\text{AgI}] \text{Ag}^+$
 $[\text{AgI}]\text{Ag}^+ + \text{I}^- \longrightarrow 2\text{AgI}$
 $2[\text{AgI}]\text{Ag}^+ + \text{SO}_4^{2-} \longrightarrow 2\text{AgI} + \text{Ag}_2\text{SO}_4$
 $3[\text{AgI}] \text{Ag}^+ + \text{PO}_4^{3-} \longrightarrow \text{Ag}_3\text{PO}_4 + 3\text{AgI}$
 thus 1 mol $[\text{AgI}]\text{Ag}^+$ requires -
 $1 \text{ mol } \text{I}^- : 1/2 \text{ mol } \text{SO}_4^{2-} : 1/3 \text{ mol } \text{PO}_4^{3-}$
 $= 1 : 1/2 : 1/3$
 $= 6 : 3 : 2$

28. The micelle formation takes place only above a particular temperature called as Kraft temperature (T_k).

29. Milli mole of NaCl in 5mL

$$\text{of 1 M NaCl} = 5 \times 1 = 5$$

NaCl required by 100 mL

of As_2S_3 sol = 5 millimole

$$\text{NaCl required by 1 L of sol} = \frac{50 \times 1000}{100}$$

$$= 50 \text{ millimole}$$

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PERIODIC TABLE

2. Till 7th period = 118 element (total magic no. addition)

8th period = 50

9th period = 50

10th period = 72

Total = 290 elements

3.

	IIIB	IVB	VB		
4 th	21	22	23		
5 th		A			
6 th	B				
7 th			C		

$$\begin{array}{ccc} \left. \begin{array}{l} 21 \\ 39 \\ 57 \end{array} \right\} 18 & \left. \begin{array}{l} 22 \\ 40 \\ 72 \end{array} \right\} 18 & \left. \begin{array}{l} 23 \\ 41 \\ 73 \end{array} \right\} 18 \\ & & \left. \begin{array}{l} 105 \end{array} \right\} 32 \end{array}$$

A = 40, B = 57, C = 105

7. (i) Group number of inert gas = zero group
or 18th group

(ii)	ns	(n-2)f	(n-1)d	np
n = 6	6s	4f	5d	6p

(iii) 2nd transition series = Y to Cd

$$\text{(iv) O}^{-2} = \frac{1s^2}{2e^-} \frac{2s^2 2p^6}{8e^-}$$

8. 3d transition series = 10 elements (21 to 30)

9. Lanthanum belongs to d block

10. 6th period all elements contain 4d electrons because in 6th period electron filled in 5d subshell. It means 4d already filled.

[illegible]

no. of orbital = 9

(one orbital occupy 3 electron)

then no. of elements $= 9 \times 3 = 27$

21.

$$\begin{array}{c} 0.65 \text{ (}\uparrow\text{)} \\ \swarrow \quad \searrow \\ \text{Na} \quad \text{Mg} \\ Z_{\text{eff}} \rightarrow x \quad x+0.65 \\ \quad \quad \text{Ca} \\ \quad \quad [x+0.65] \end{array} \left. \vphantom{\begin{array}{c} \text{Na} \\ \text{Mg} \\ \text{Ca} \\ [x+0.65] \end{array}} \right] \text{constant}$$

29. Li^+ & Mg^{2+} [due to diagonal relationship]

32. Atomic Number = 78 (Element - Platinum)
as per e^- configuration ($3d^{10} + 4d^{10} + 5d^9$)

34. (i) $N > F$ (ii) $Cl^- > Cl$ (iii) $O < S$ (iv) $Fe^{+2} > Fe^{+3}$

37. $\text{Ge} > \text{Br} > \text{C} > \text{F}$

40. (i) $\begin{array}{ccc} \text{S} & & \text{Cl} \\ 3p^4 & < & 3p^5 \quad \text{IE}_1 \\ \downarrow -e & & \downarrow -e \\ 3p^3 & > & 3p^4 \quad \text{IE}_2 \end{array}$

(ii) P Mg

$3s^2 3p^3$	$>$	$3s^2$	IE_1
$\downarrow 2e^-$		$\downarrow 2e^-$	
$3s^2 3p^1$	$<$	$2p^6$	IE_3

(iii) $Al \approx Ga$ or $Al > Ga$

(size almost same due to transition contraction)

$$\text{Al} < \text{Ga} \text{ (IE)}$$

(iv) B $\quad$ C
 $2s^2 2p^1 < 2s^2 2p^2 \quad IE_1$
 $\downarrow -e \quad \downarrow e^-$
 $2s^2 > 2s^2 2p^1 \quad IE_2$

41. Order of IE

$$\begin{array}{ccccccc} \text{Si} & < & \text{P} & > & \text{S} & < & \text{Cl} \\ 3s^2 3p^2 & & 3s^2 3p^3 & & 3s^2 3p^4 & & 3s^2 3p^5 \\ \\ \text{Cl} & > & \text{P} & > & \text{S} & > & \text{Si} \\ 1256 & & 1012 & & 999 & & 786 \end{array}$$

44. $1s^2 2s^2 2p^6 3s^1 \xrightarrow[\text{IE}_1]{-e} \frac{1s^2, 2s^2 2p^6}{\text{noble gas e}^- \text{ configuration (most stable)}} \rightarrow \text{after that big jump}$

45. $\frac{IE_I}{940}$ $\frac{IE_{II}}{2080}$ $\frac{IE_{III}}{3090}$ $\frac{IE_{IV}}{4140}$ $\frac{IE_V}{7030}$ $\frac{IE_{VI}}{7870}$ $\frac{IE_{VII}}{16000}$ $\frac{IE_{VIII}}{19500}$

Big jump between IP_{VI} and IP_{VII}
so valence electron is 6 thus it belongs to
group 16.

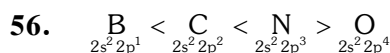
46. $M_{(g)} \xrightarrow[IE_1]{e^-} M_{(g)}^+ \xrightarrow[IE_{II}]{e^-} M_{(g)}^{+2}$

$$M_{(q)} \rightarrow M_{(q)}^{+2} + 2e^{-} \quad \dots(5)$$
$$M_{(g)} \rightarrow M_{(g)}^{+} + e^{-} \quad \dots(3)$$

→ IE_o of M = 5-3

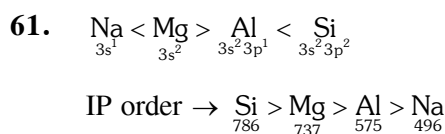
48 to 53

	IE ₁	IE ₂	IE ₃	
P	300	549	920	(Non metal)
Q	99 $\xrightarrow{\text{large jump}}$	734	1100	V.S.e ⁻¹ 1 (IA)
R	118 $\xrightarrow{\text{large jump}}$	1091	1652	V.S.e ⁻¹ 1 (IA)
S	176	347 $\xrightarrow{\text{large jump}}$	1848	V.S.e ⁻¹ 2 (IIA)
T	497	947	1500	(Noble Gas)

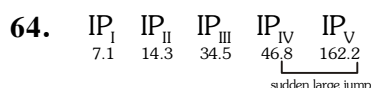


IP Order $\rightarrow B < C < O < N$
 $8.3 \quad 11.3 \quad 13.6 \quad 14.5$

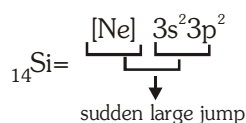
60. Atomic number of inert gas = Z
 Second highest IE in a period = halogens (Z-1)



62. Metallic character order : $Na > Mg > Be > Si > P$



Valence electron for this element = 4



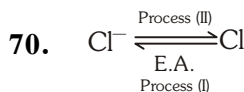
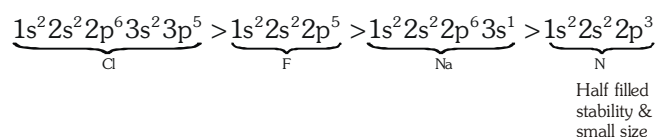
66. (i) $IE_1 [Mg > Al]$ penetration power

(ii) $IE_1 [Na < Mg]$ Z_{eff}

(iii) $IE_2 [Mg^+ < Na^+]$
 $3s^1 \quad 2p^6$
 (inert gas configuration)

(iv) $IE_3 [Mg^{+2} > Al^{+2}]$
 $3s^1 \quad 3s^1$
 (inert gas configuration)

68. Order of E.A.



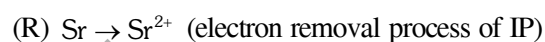
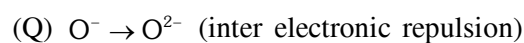
[I.E. of process (II) = E.A. pf Process (I)]

93. (a) Energy released

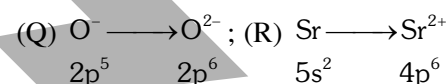


Because $N \rightarrow N^-$ endo

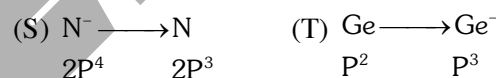
(b) Energy absorbed



(c) Inert gas configuration



(d) Half filled configuration



CHEMICAL BONDING

2. $I_2 + KI \rightarrow KI_3$
In I_3^- hyb. is sp^3d with 3 lone pair so shape is linear.

3. Species No. of unpaired

O_2 2

O_2^+ 1

O_2^- 1

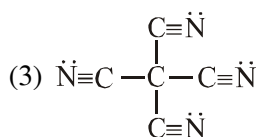
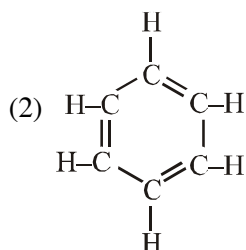
O_2^{-2} 0

5. Bond angle 120° means sp^2 hybridisation
% p character is nearly 66%.

9. Solubility of ionic compound depends upon lattice energy or hydration energy and not explained by polarisation.

11. $\left[\begin{matrix} \sigma = 2 \\ l.p. = 1 \end{matrix} \right]$ hybridisation : sp^2 ; so trigonal planar

12. (1) $\ddot{N} \equiv C - C \equiv \ddot{N}$

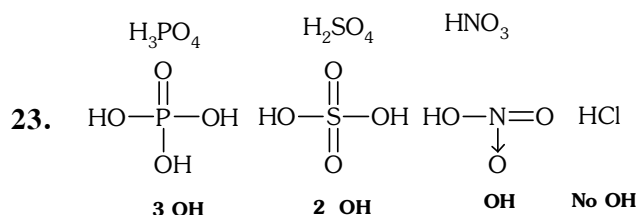


(4) $\ddot{O} = C = C = C = \ddot{O}$

15. (i) Boiling point of H_2O_2 is greater than H_2O (due to H-bonding)
(ii) Number of hydrogen bond in ethylene glycol is lesser than glycerol.
(iii) o-nitrophenol has low boiling point than para nitrophenol.
(iv) In ice each oxygen atom bonded with four hydrogen atom, two hydrogen covalently bonded and another two hydrogen bonded with H-bond.

18. Bond angle $\propto$ % 's' character
% s character increases, bond strength increases.
Bond length decreases

22. $N_2^+ = 2\pi$ bonds and $1/2 \sigma$ bond (due to MOT)

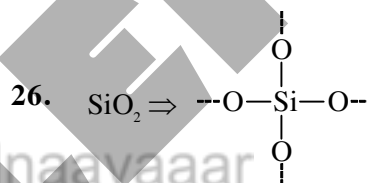


24. $SF_4 \rightarrow$ see saw shape

CCl_4 tetrahedral; no l.p. at central atom & all terminal atoms are same, so all bond angles are same.

$CHCl_3$, hybridisation sp^3 but all terminal atoms are not same.

XeF_6 hybridisation sp^3d^3 (all bond angles are not same) – Capped octahedral.



No resonance (all single bond)

28. (i) ClF_3 sp^3d hybridisation with 2 l.p.,
so 'T' shape

(ii) In SF_4 due to l.p.-b.p. repulsion equatorial bond angle is less than 120° .

(iii) In $[ICl_4]^-$ sp^3d^2 hyb. with two l.p. shape – square planar, bond angle 90°

(iv) In XeF_2 sp^3d hybridisation with 3 l.p., shape – linear

29. (i) $NO_3^- > NH_3 > NH_2^-$ (B.A. order)

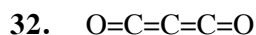
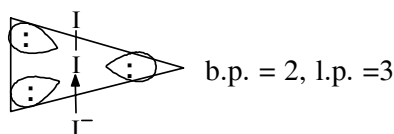
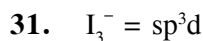
sp^2 sp^3 sp^3
1 l.p. 2 l.p.

(ii) In $(CH_3)_3B$ hybridisation of carbon is sp^3 (non planar)

(iii) $NH_4Cl \rightarrow NH_4^+Cl^-$ in NH_4^+ hyb. of N is sp^3

(iv) $BF_3 = BCl_3 = BBr_3 = BI_3$

all have same bond angle.



[3 carbon atoms present linearly]



sp^3

l.p. = 0

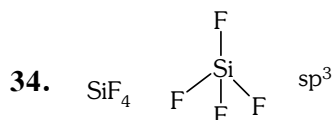
tetrahedral



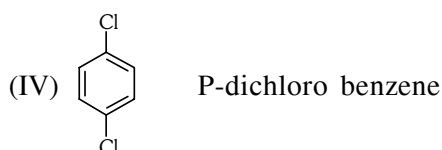
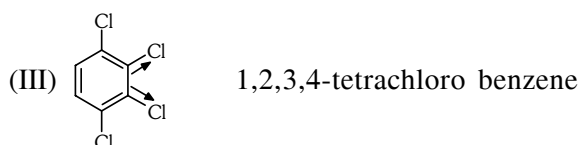
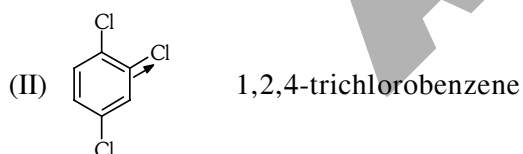
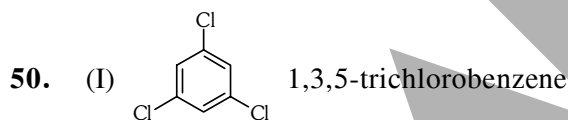
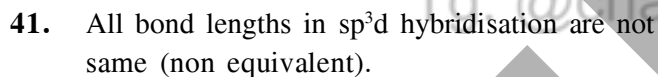
sp^3d^2

l.p. = 2

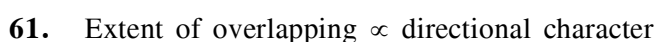
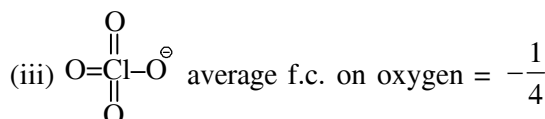
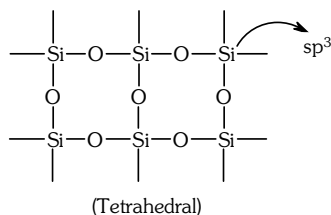
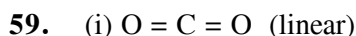
square planar



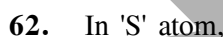
all bond lengths are equal



Dipole moment order = III > II > I = IV



$$\text{Extent of overlapping} \propto \frac{1}{\text{size of orbital}}$$



G.S. = no. of unpaired $e^- = 2$

(E.S.)_I = no. of unpaired $e^- = 4$

(E.S.)_{II} = no. of unpaired $e^- = 6$ (SO_3)

SH_6 not possible

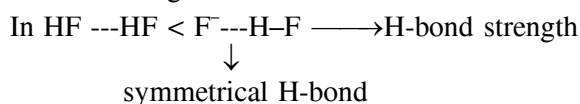
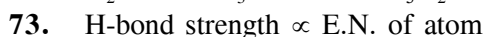
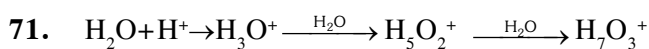
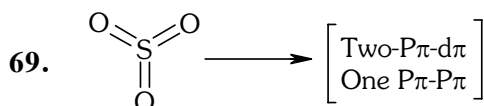
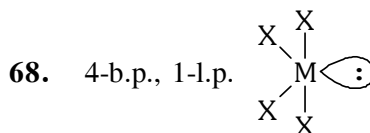
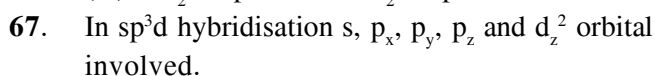
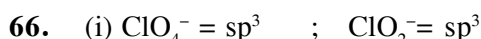
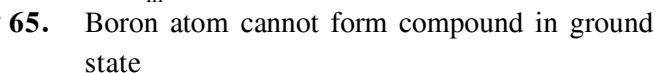
In 'T' atom

G.S. = no. of unpaired $e^- = 1$

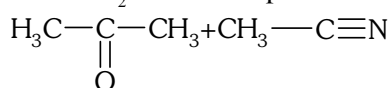
(E.S.)_I = no. of unpaired $e^- = 3$

(E.S.)_{II} = no. of unpaired $e^- = 5$

(E.S.)_{III} = no. of unpaired $e^- = 7$



74. $\text{KCl} + \text{H}_2\text{O} \Rightarrow$ ion-dipole attraction



dipole-dipole attraction

$\text{HCl} + \text{Cl}_2 \Rightarrow$ dipole induced dipole attraction

75. Inert gas + $\text{H}_2\text{O} \Rightarrow$ dipole-induced dipole (Debye attraction)

79. Vanderwaal force of attraction $\propto$ molecular weight/surface area.

80. Hydration energy step not involved in Born-Haber cycle

82. $\text{HCl}(\text{aq}) \rightarrow \text{H}^+ + \text{Cl}^-$

AlF_3 molten $\rightarrow \text{Al}^{+3} + \text{F}^-$

Graphite $\rightarrow$ delocalised of ' π ' electron

$\text{Na}(\text{s}) \rightarrow$ metallic solid (free electron)

$\text{AlCl}_3(\text{aq}) \rightarrow \text{Al}^{+3} + \text{Cl}^-$

83. Ionic bond NaCl , CsBr , CsF , BaBr_2 , SrO , CaO

84. Boiling point $\text{He} < \text{H}_2$ - VWF

93. (i) Cr^{+2} , Cr^{+3} , Cr^{+6}



oxidation state of metal $\uparrow$

polarisation $\uparrow$

covalent character $\uparrow$

(ii) ZnO (O^{2-}), ZnS (S^{2-})



anionic size $\uparrow$, polarisation $\uparrow$,

covalent character $\uparrow$, ionic character $\downarrow$

(iii) BeCl_2 MgCl_2 CaCl_2 SrCl_2 BaCl_2



(cationic size $\uparrow$, polarisation $\downarrow$, ionic character $\uparrow$)

(iv) KCl AgCl

$\text{K}^+ \rightarrow$ inert gas configuration cation

$\text{Ag}^+ \rightarrow$ Pseudo inert gas configuration cation

polarisation power order $\rightarrow \text{K}^+ < \text{Ag}^+$

97. As per M.O.T. fill the electrons.

99. Due to smaller size BeF_2 has high hydration energy

101.

(i) In AgCl more polarisation so less solubility

(ii) In KI more polarisation so more solubility in organic solvent

(iii) BeC_2O_4 more soluble due to high hydration energy

(iv) CaCrO_4 has more solubility due to high hydration energy.

103. Hydrated ionic chloride converted into anhydrous on heating

104. For polyatomic anion

$$\text{Thermal stability} \propto \frac{\text{size of cation}}{\text{charge of cation}} \propto \frac{1}{\phi}$$

106. (i) $\text{NaNO}_3 \xrightarrow{\Delta} \text{NaNO}_2 + \text{O}_2$

(ii) $\text{Ag}_2\text{CO}_3 \xrightarrow{\Delta} \text{Ag}_2\text{O} + \text{CO}_2 \xrightarrow{\Delta} 2\text{Ag} + \frac{1}{2} \text{O}_2$

Silver oxide is less stable

(iii) $\text{K}_2\text{CO}_3 \xrightarrow{\Delta} \text{No thermal decomposition}$

(iv) $\text{Li}_2\text{CO}_3 \xrightarrow{\Delta} \text{Li}_2\text{O} + \text{CO}_2$

109. $\text{P}-\text{O} > \text{S}-\text{O} > \text{Cl}-\text{O}$

111. Bond order (B.O.)

CO 3

CO_2 2

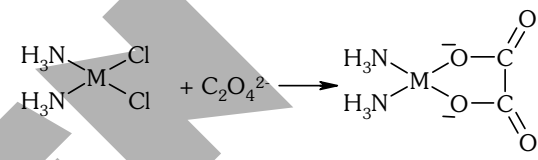
CO_3^{-2} 1.33

as B.O. increases, B.L. decreases.

112. $\text{F}-\overset{\cdot\cdot}{\underset{\text{O}}{\underset{\parallel}{\text{S}}}}-\text{F}$ Pyramidal

COORDINATION COMPOUNDS

- | | | | |
|------------|---|------------|--|
| 4. | $[Pt(NH_3)_5Cl]Cl_3 \rightarrow [Pt(NH_3)_5Cl]^{+3} + 3Cl^-$ | 24. | Molar conductance $\propto$ no. of ions |
| 5. | $[Co(NH_3)_5Cl]Cl_2$ with $AgNO_3$ (excess) gives 2 moles of $AgCl$. | 25. | $PtCl_4 \cdot 2KCl \rightarrow K_2[PtCl_6]$
C.N. = 6 |
| 8. | $M - C = O$
negative charge on central atom ($\uparrow$)
$= M-C$ BE ($\uparrow$), $M-C$ B.L. ($\downarrow$)
$= C-O$ B.E. ($\downarrow$), $C-O$ B.L. ($\uparrow$) | 26. | $[Cr(H_2O)_6]Cl_3 + AgNO_3 \rightarrow AgCl$
1 mole excess 3 mole |
| 9. | $C-O$ bond length is slightly higher in $Fe(CO)_5$ due to present of synergic bonding. | 28. | % of chlorine = $\frac{\text{ionised Cl}}{\text{total Cl}} \times 100$ |
| 10. | In metal carbonyl compound
$C-O$ bond order $\propto$ +ve charge on central metal
$\propto \frac{1}{\text{-ve charge on central metal}}$ | 33. | $Fe(CO)_x$ then $x = 5$ according to EAN rule
$26 + 2x = 36$
$2x = 10$ ($x = 5$) |
| 12. | $H_2C-CH_2-\ddot{N}H-CH_2-CH_2$ dien

$:NH_2$ $:NH_2$
diethylenetriamine | 37. | $[Ma_3b_3] -$ two G.I. |
| 13. | $[Pt(NH_3)_2(CN)_2] \dots(2)$
$[Pt(NH_3)_2(NC)_2] \dots(2)$
$[Pt(NH_3)_2(CN)(NC)] \dots(2)$
Total = 6 | 39. | 
at cis position. |
| 14. | (i) $K[CrF_4O]$ oxidation state of Cr is +6 not possible | 40. | $Fe(CO)_5$ EAN = 36 |
| 17. | $K_4[Fe(CN)_6]$, O.S. of Fe = +2
correct name is potassium hexacyanidoferrate (II) | 42. | $trans-[Co(en)_2Cl_2]^+$
optically inactive, due to presence of P.O.S. |
| 19. | trioxalatoaluminate (III) - $[Al(Ox)_3]^{3-}$
tetrafluoroborate (III) - $[BF_4]^-$ | 43. | $[CoCl_2(OH)_2(NH_3)_2]Br$
ionisation, geometrical, optical (cis form)
No ambidentate ligand
$\therefore$ no linkage |
| 20. | In $[Fe(\eta^5-C_5H_5)_2]$
EAN of Fe = $26 - 2 + 2(6) = 36$
$[Cr(CO)_6]$
EAN of Cr = $24 - 0 + 2(6) = 36$ | 44. | Isomer I & II are G.I. |
| 22. | Tollen's reagent = $[Ag(NH_3)_2]^+$
Ag atomic no. = 47
EAN = $47 - 1 + 2 \times 2 = 50$ | 47. | Linkage isomerism exhibit in presence of ambidentate ligand
$NCS^- \rightarrow SCN^-$ |
| 23. | $Co(CO)_4$ EAN = $27 - 0 + 2(4) = 35$ (O.A.)
and with the help of dimerisation, it attains stability. | 49. | $[Fe(en)_2(H_2O)_2]^{+2} + en \rightarrow [Fe(en)_3]^{+2}$
$Fe^{+2} = 3d^6, t_{2g}^6 e_g^0$ low spin, diamagnetic |
| | | 60. | $[Co(en)_2Cl_2] -$ G.I. 2, O.I. 2, S.I. = 3 |
| | | 62. | (1) $[Fe(CN)_6]^{3-}$ EAN = 35
$[Fe(NH_3)_6]^{3+}$ EAN = 35
(2) $[Cr(NH_3)_6]^{3+}$ EAN = 33
$[Cr(CN)_6]^{3-}$ EAN = 33
(3) $[FeF_6]^{3-}$ EAN = 35
$[Fe(CN)_6]^{3-}$ EAN = 35
(4) $[Ni(CO)_4]$ EAN = 36
$[Ni(CN)_4]^{2-}$ EAN = 34 |

65. $\text{Fe}(\text{CO})_5 - \text{Fe}(26) = 3d^6 4s^2$

In formation of complex $= 3d^8$ [due to effect of ligand]

hybridisation = dsp^3 , diamagnetic

$[\text{Fe}(\text{en})_3]^{3+} = d^2sp^3$, diamagnetic

68. In $[\text{Fe}(\text{H}_2\text{O})_5\text{NO}]^{2+}$

$\text{Fe}^+ = 3d^6 4s^1$

in presence of ligand $\text{Fe}^+ = 3d^7 4s^0$

hybridisation = sp^3d^2 ,

spin only magnetic moment = 3.87 B.M.

69. (i) $[\text{Ag}(\text{NH}_3)_2]^+ - sp$

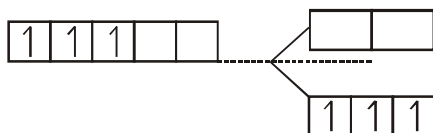
(ii) $[\text{NiCl}_4]^{2-}$, VO_4^{3-} and MnO_4^- - tetrahedral

(iii) $[\text{Cu}(\text{NH}_3)_4]^{2+} - dsp^2$

$[\text{Pt}(\text{NH}_3)_4]^{2+} - dsp^2$

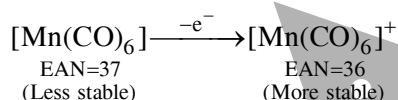
$[\text{Ni}(\text{CN})_4]^{2-} - dsp^2$

70. $\text{Cr}^{+3} = 3d^3$

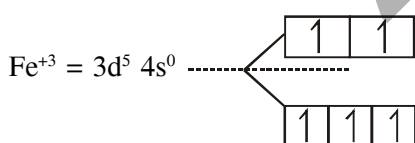


d^2sp^3 , $\mu_s = 3.8$ B.M. approx

71. $\text{Mn}(\text{CO})_6$ can act as reducing agent because the metal carbonyl is stable when EAN is equal to nearest noble gas configuration.



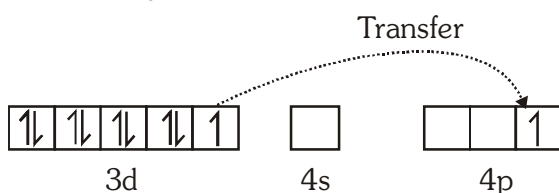
75. In $[\text{FeF}_6]^{3-}$



sp^3d^2 , high spin complex, $\mu_s = 5.9$ B.M.

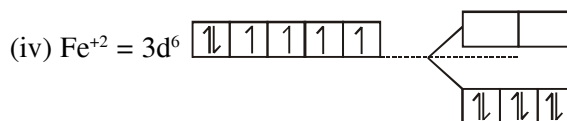
76. (i) $[\text{Cu}(\text{H}_2\text{O})_4]^{+2}$ $\text{Cu}^{+2} = 3d^9$ No. of unpaired $e^- = 1$

(ii) $[\text{Cu}(\text{NH}_3)_4]^{+2}$ $\text{Cu}^{+2} = 3d^9$



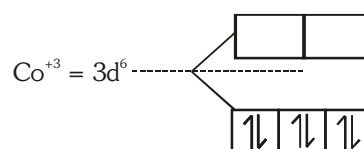
No. of unpaired electron = 1

(iii) $\text{Mn}^{+2} = 3d^5 4s^0$ No. of unpaired $e^- = 5$



No. of unpaired electron = 0

78. In $[\text{Co}(\text{NH}_3)_6]^{3+}$



inner orbital, diamagnetic nature

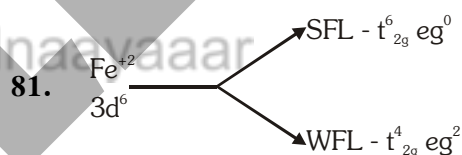
79. In $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$ complex one unpaired electron present in 4p orbital

Hybridisation = dsp^2 , square planar

$\text{BaCl}_2 + \text{SO}_4^{2-} \rightarrow \text{BaSO}_4$ complex

80. In $[\text{CoF}_6]^{3-}$, hybridisation - sp^3d^2

$[\text{Co}(\text{Ox})_3]^{3-}$, hybridisation = d^2sp^3



83. (i) $[\text{PtCl}_2(\text{NH}_3)_2] - \text{Ma}_2\text{b}_2$

(ii) $[\text{PdCl}_2\text{BrI}] - \text{Ma}_2\text{bc}$

(iii) $[\text{Pt}(\text{NH}_3)_2\text{ClBr}] - \text{Ma}_2\text{bc}$

(iv) $[\text{Pt}(\text{NH}_3)_3\text{Cl}] - \text{Ma}_3\text{b}$ G.I. absent

84. $[\text{Cr}(\text{NH}_3)_6]\text{Cl}_3$, $\text{Cr}^{+3} = 3d^3$ coloured

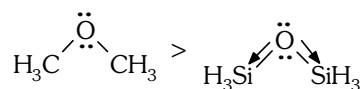
$[\text{Ni}(\text{CN})_4]^{2-}$ is colourless

85. $[\text{Co}(\text{en})_3]^{3+}$ has highest value of K_f among complex due to chelation

86. $\text{Pb}(\text{C}_2\text{H}_5)_4$ is σ bonded O.M.C.

p-BLOCK ELEMENT

2. $\text{Si} \leftarrow \text{O} > \text{C}-\text{O}$ (bond length)
back bonding



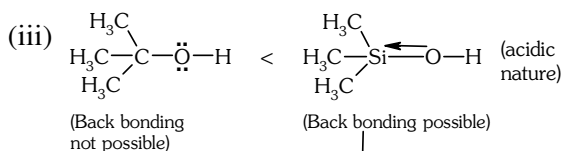
Back bonding is not possible due to absence of vacant orbital

Back Bonding possible. (electron density dispersed)

(Lonepair donation possible easily)

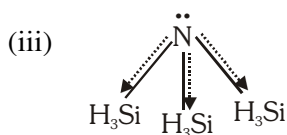
So work as more Lewis base

(Lewis base strength)

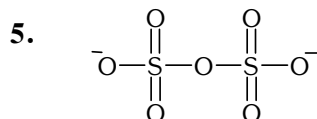


So conjugated is more stable thus more acidic in nature

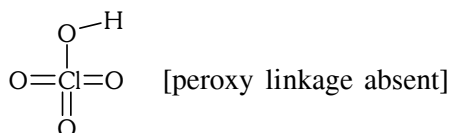
3. (i) $\text{N}(\text{SiH}_3)_3$ Back bonding is possible (planar)
 $\text{N}(\text{Me})_3$ Back bonding is not possible (pyramidal)
- (ii) $\text{H}_3\text{C}-\text{N}=\text{C}=\text{O}$ back bonding not possible (bent)
 $\text{H}_3\text{Si}-\text{N}=\text{C}=\text{O}$ back bonding present so shape is linear



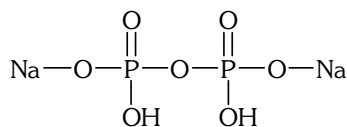
Back bonding possible so all bond lengths are equal and less than expected bond length



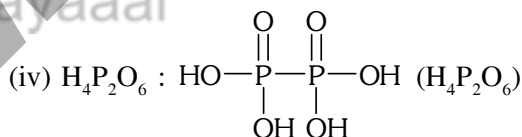
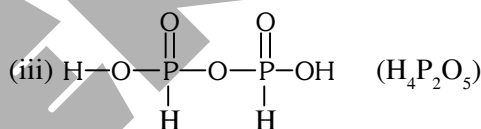
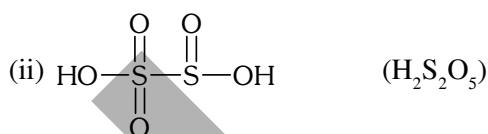
7. Per chloric acid – HClO_4



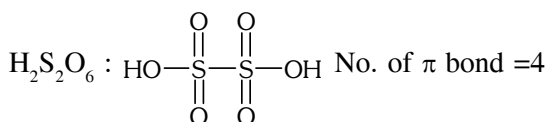
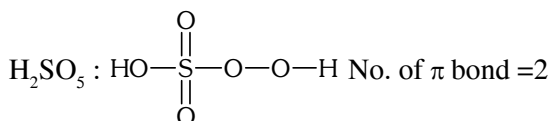
10. Sodium dihydrogen pyrophosphate – $\text{Na}_2\text{H}_2\text{P}_2\text{O}_7$



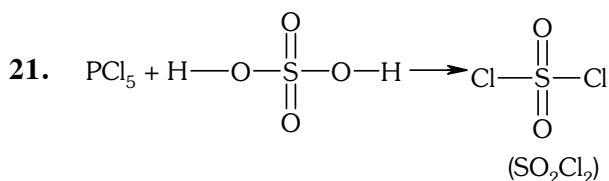
11. (i) $\text{H}-\text{O}-\text{S}(=\text{O})_2-\text{O}-\text{S}(=\text{O})_2-\text{O}-\text{H}$ ($\text{H}_2\text{S}_2\text{O}_7$)



12. $\text{H}_2\text{S}_2\text{O}_5$: $\text{HO}-\text{S}(=\text{O})_2-\text{S}(=\text{O})_2-\text{OH}$ No. of π bond = 3

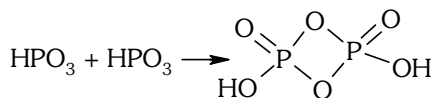


19. $\text{Na}_2\text{S}_2\text{O}_3 + \text{I}_2 \rightarrow \text{Na}_2\text{S}_4\text{O}_6 + \text{NaI}$

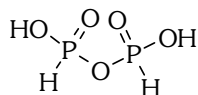


22. When KI added into I_2 , KI_3 formed and solubility of I_2 increase.

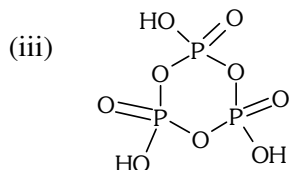
23. (i) Dimetaphosphoric acid



(ii) 2 mole $H_3PO_3 \rightarrow H_4P_2O_5$



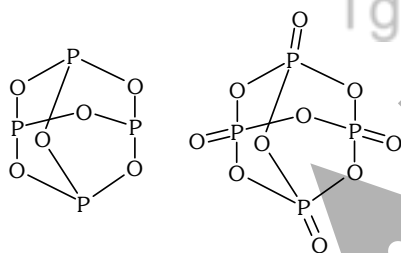
pyrophosphorous acid



Cyclic trimetaphosphoric acid

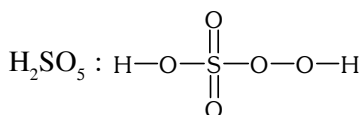
(iv) Hypophosphorous acid - H_3PO_2 $\begin{array}{c} O \\ \parallel \\ H-P-OH \\ | \\ H \end{array}$

25. P-O-P linkage in P_4O_6 and P_4O_{10} are six

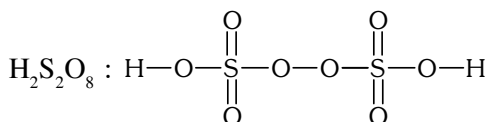


26. N_2O is a neutral oxide

28. CrO_5 : $\begin{array}{c} O \\ \parallel \\ O-Cr-O \\ \diagup \quad \diagdown \\ O \quad O \end{array}$ No. of peroxy linkage = 2



No. of peroxy linkage = 1



number of peroxy linkage = 1

29. AgF - soluble in water

$AgCl$ - white ppt,

$AgBr$: light yellow ppt

AgI : dark yellow ppt

32. When $X = H, NH_3, CH_3NH_2$ then $[BH_2(X)_2]^+ [BH_4]^-$

if $X = CO, THF$ then $2[BH_3 \leftarrow X]$

33. $Br_2 + F^- \rightarrow Br^- + F_2$ reaction not possible

order of oxidising $\rightarrow F_2 > Cl_2 > Br_2 > I_2$

34. $I_2 + H_2O \rightarrow HI + O_2$ reaction non spontaneous.

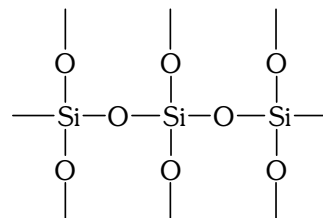
35. order of BP : $HF > HI > HBr > HCl$

order of MP : $HI > HF > HBr > HCl$

acidic strength $\propto \frac{1}{P_{K_a}}$

so, order of P_{K_a} : $HF > HCl > HBr > HI$

41. SiO_2 is a giant molecule it means one Si atom with four oxygen atom and one oxygen atom combine with two Si atom



hybridisation of Si = sp^3

44. Only Kr and Xe only two element of inert gas form compound but mainly Xe form compound.

48. SF_6 cannot be hydrolysed due to steric hindrance of fluoride.

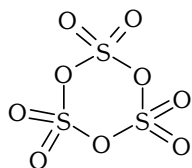
49. (ii) $NH_4NO_3 \rightarrow N_2O + H_2O$

50. $NH_3 + Cl_2 \rightarrow NCl_3 + HCl$
(excess)

52. $Mg_3N_2 + H_2O \rightarrow Mg(OH)_2 + NH_3$

54. order of bond energy - $Cl_2 > Br_2 > F_2 > I_2$

55. In solid state, SO_3 form trimer (S_3O_9)



61. H_2SO_4 less volatile due to presence of H-bonding

62. (i) $\text{Si}^{+4} < \text{Sn}^{+4} < \text{Pb}^{+4}$ [due to inert pair effect]

(ii) size of halogen ($\uparrow$)

= polarisation ($\uparrow$)

= ionic character ($\downarrow$)

(iv) Liquification of noble gases increases down the group, due to increasing in London force.

63. $\text{NaOH} + \text{P}_4 + \text{H}_2\text{O} \rightarrow \text{NaH}_2\text{PO}_2 + \text{PH}_3$

68. $\text{Cl}_2 + \text{NaOH} \xrightarrow{\text{dil. \& cold}} \text{NaCl} + \text{NaOCl}$

69. $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O} \xrightarrow{\Delta} \text{NaBO}_2 + \text{B}_2\text{O}_3$
(A) (B) (C)

$\text{H}_3\text{BO}_3 \xrightarrow{\Delta} \text{B}_2\text{O}_3 + \text{H}_2\text{O}$

74. In P_4 , sp^3 hybridisation $\therefore \%p = \frac{3}{4} \times 100 = 75$

80. A = H_2SO_4

B = $\text{H}_2\text{S}_2\text{O}_7$

C = $\text{H}_2\text{S}_2\text{O}_6$

D = SO_3

E = H_2SO_5

F = $\text{H}_2\text{S}_2\text{O}_8$

81. $\text{XeF}_4 + \text{SbF}_5 \rightarrow [\text{XeF}_3]^+ [\text{SbF}_6]^-$

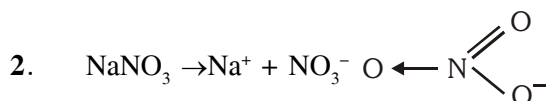
82. $\text{PH}_4\text{I} + \text{KOH} \rightarrow \text{PH}_3 + \text{KI} + \text{H}_2\text{O}$
(A) (B)

83. CH_3COOH forms dimer due to H-bonding.

84. $\text{K}_2\text{HPO}_3 \Rightarrow$ no acidic H present.

S-BLOCK ELEMENT

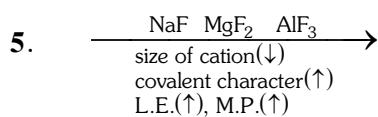
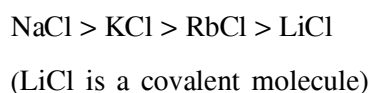
1. $L.E. \propto q_1 q_2 \propto \frac{1}{\text{size}}$



3. $L.E. \propto q_1 q_2 \propto \frac{1}{\text{size}}$

order of size $\text{Mg}^{+2} < \text{Ca}^{+2}$
 $\text{O}^{-2} < \text{S}^{-2}$ so, MgO has highest
lattice energy.

4. Correct order of melting point :



all are ionic (dominant behaviour)

6. (a) AlCl_3 is non conducting in fused state,
conducting only in aq. state.

(b) $\text{Li}^+(\text{aq}) > \text{Cs}^+(\text{aq})$ - size
 $\text{Li}^+(\text{aq}) < \text{Cs}^+(\text{aq})$ - mobility

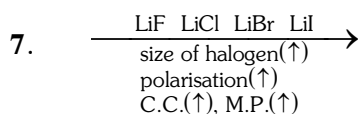
$\therefore \text{mobility} \propto \frac{1}{\text{size}}$

(c) Covalent character ($\uparrow$) = volatile properties ($\uparrow$)



because + charge on M increasing.

(d) $\text{BeSO}_4 > \text{BaSO}_4$ - solubility



8. order of reducing strength

(i) IA - $\text{Li} > \text{Cs} \approx \text{Rb} \approx \text{K} > \text{Na}$

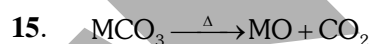
(ii) IIA - $\text{Ba} > \text{Sr} > \text{Ca} > \text{Mg} > \text{Be}$

9. $\left[\text{mobility} \propto \frac{1}{\text{size of hydrated ion}} \right]$

11. Polarisation $\propto \frac{1}{\text{size of cation}} \propto \text{size of anion}$

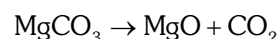
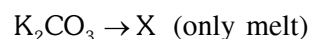
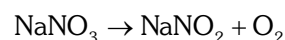
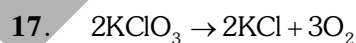
$\text{Na}_2\text{S} < \text{MgS}$ - covalent character

13. Covalent character increases = solubility in
organic solvent ($\uparrow$) so LiI is maximum soluble
in organic solvent



down the group, stability of carbonate ($\uparrow$)
stability of oxide ($\downarrow$)

16. Na, K, Rb and Cs bicarbonate exist in solid
state.



18. $K_p = P_{\text{CO}_2}$

$P_{\text{CO}_2}(\uparrow) = K_p(\uparrow)$

Stability order :



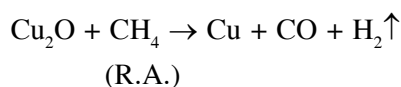
21. For alkali and alkaline earth metal oxide,
basic nature down the group increases

ZnO is amphoteric oxide

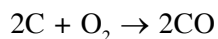
So, basic nature - $\text{BeO} < \text{MgO} < \text{CaO}$

METALLURGY

1. Cu has Cu_2O impurity



4. as per ellingham diagram



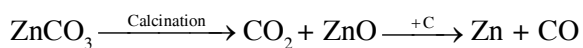
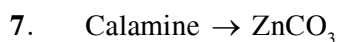
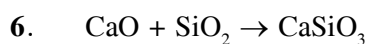
$$\Delta S = 2 - 1$$

$$= +1$$

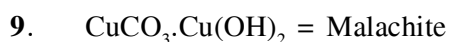
$$\text{Slope} = -\Delta S$$

$$= -ve$$

5. For Ag & Au – Hydrometallurgy



8. Galena $\Rightarrow \text{PbS}$ (S^{-2} Sulphide ore) froth floatation.

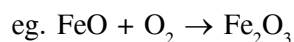


10. $[\text{Ag}(\text{CN})_2]^-$ & $[\text{Zn}(\text{CN})_4]^{2-}$

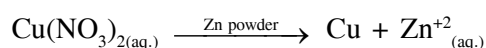
$$x = 2, y = 4$$

12. Lower O.S. $\rightarrow$ Higher O.S.

Usually it is done by roasting.



13. $\text{CuCO}_3 \cdot \text{Cu(OH)}_2 \xrightarrow{\Delta} \text{CuO} \xrightarrow{\text{dil. HNO}_3}$



17. $\text{Cr}_2\text{O}_3 + \text{Al} \rightarrow \text{Al}_2\text{O}_3 + \text{Cr}$

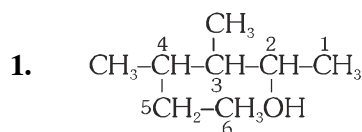
Aluminothermite

18. Ag_2S – hydrometallurgy.

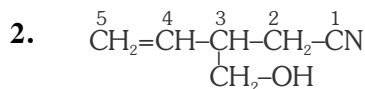
21. Oxygen is liberated at anode.

25. Self reduction = Cu

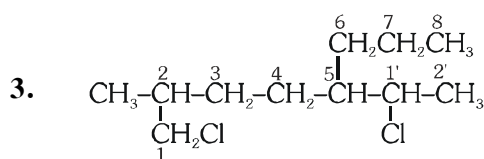
26. Carbon reduction = Zn, Fe



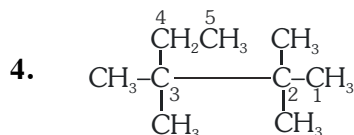
3,4-Dimethylhexan-2-ol



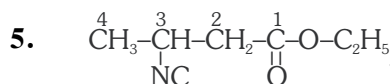
3-(Hydroxymethyl)pent-4-ene-nitrile



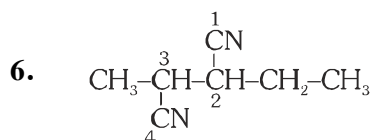
1-Chloro-5-(1'-chloroethyl)-2-methyloctane



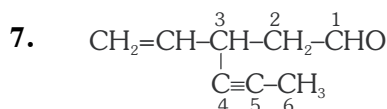
2,2,3,3-Tetramethylpentane



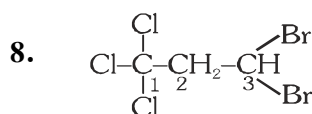
Ethyl 3-isocyanobutanoate



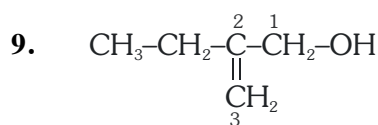
2-Ethyl-3-methylbutanedinitrile



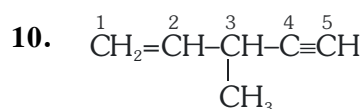
3-Ethenylhex-4-yn-1-al



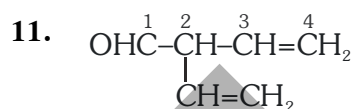
3,3-Dibromo-1,1,1-trichloropropane



2-Ethylprop-2-en-1-ol



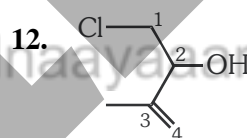
3-Methylpent-1-en-4-yne



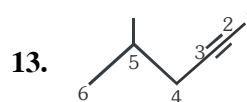
2-Ethenylbut-3-enal

OR

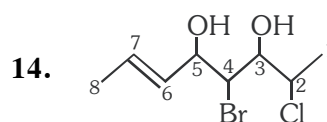
2-Ethenylbut-3-en-1-al



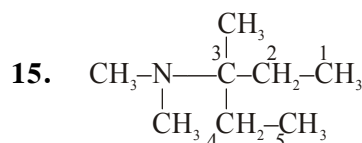
1-Chloro-3-methylbut-3-en-2-ol



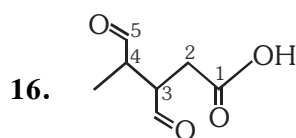
5-Methylhex-2-yne



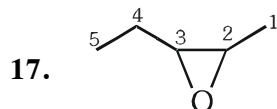
4-Bromo-2-chlorooct-6-ene-3,5-diol



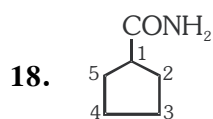
N, N, 3-Trimethyl pentan-3-amine



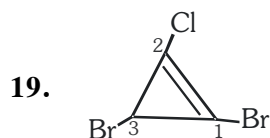
3-Formyl-4-methyl-5-oxopentanoic acid



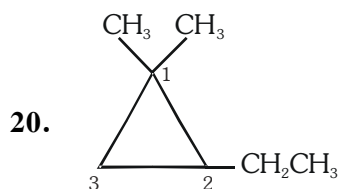
2,3-Epoxy pentane



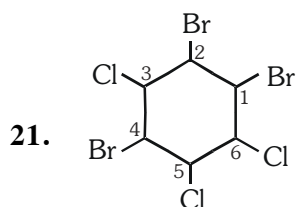
Cyclopentanecarboxamide



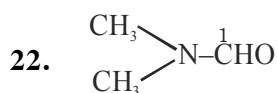
1,3-Dibromo-2-chlorocycloprop-1-ene



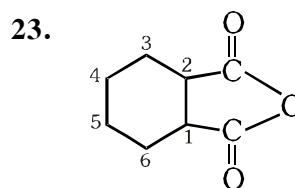
2-Ethyl-1,1-dimethylcyclopropane



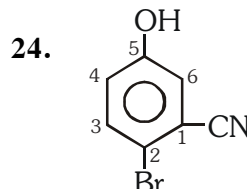
1,2,4-Tribromo-3,5,6-trichlorocyclohexane



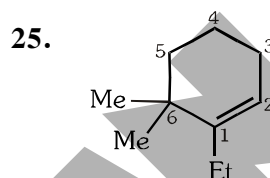
N,N-Dimethylmethanamide



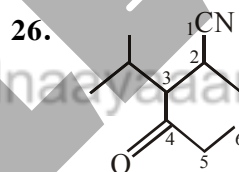
Cyclohexane-1,2-dicarboxylic anhydride



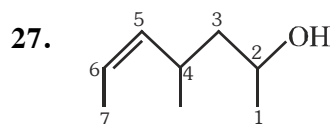
2-Bromo-5-hydroxy benzene carbonitrile



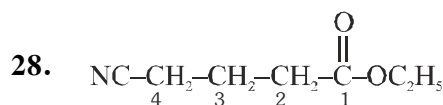
1-Ethyl-6,6-dimethyl-1-cyclohexene



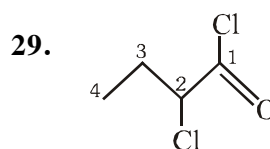
3-Isopropyl-2-methyl-4-oxo hexane nitrile



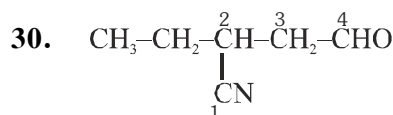
4-Methylhept-5-en-2-ol



Ethyl 4-cyanobutanoate



2-Chlorobutanoyl chloride

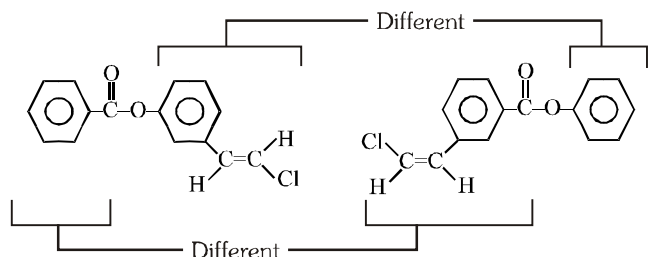


2-Ethyl-4-oxobutanenitrile

STRUCTURAL ISOMERISM

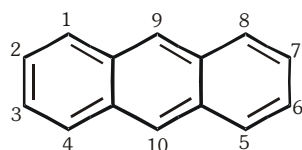
RACE # 02

1.



Different group/substituent attached to polyvalent functional group :- Metamerism.

2.

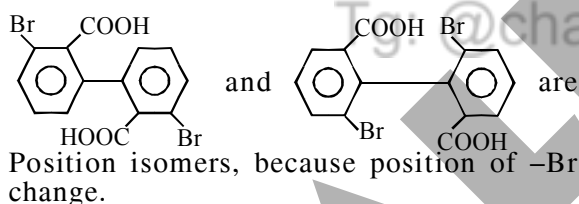


Anthracene

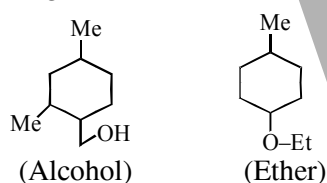
3-structural isomers possible when one H-atom replaced by chlorine

- Position (1,4,5,8) Identical
- Position (2,3,6,7) Identical
- Position (9, 10) Identical

3.



4.



Both having different functional group, so they are functional isomers.

5. (Concept : Monovalent radical of saturated hydrocarbon)

$\text{CH}_3\cdot$: 1, $\text{C}_2\text{H}_5\cdot$: 1, $\text{C}_3\text{H}_7\cdot$: 2, $\text{C}_4\text{H}_9\cdot$: 4, $\text{C}_5\text{H}_{11}\cdot$: 8

$\text{C}_4\text{H}_{11}\text{N}$;

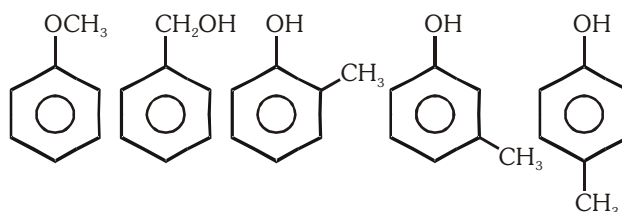
p-amine : $\text{C}_4\text{H}_9 - \text{NH}_2$: 4

s-amine : $\left[\begin{array}{l} \text{CH}_3 - \text{NH} - \text{C}_3\text{H}_7 : 2 \\ \text{C}_2\text{H}_5 - \text{NH} - \text{C}_2\text{H}_5 : 1 \end{array} \right] 3$

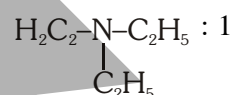
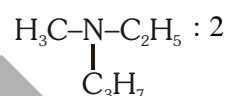
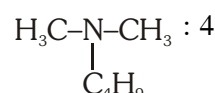
t-amine : $\text{H}_3\text{C} - \text{N}(\text{CH}_3) - \text{C}_2\text{H}_5$: 1

Total amine : 4 + 3 + 1 = 8

6. $\text{C}_7\text{H}_8\text{O}$;



7. $\text{C}_6\text{H}_{15}\text{N}$;
3° amine :



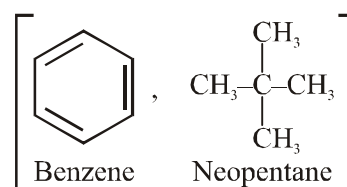
Total : 4 + 2 + 1 = 7

8. $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$
(n-Butane)

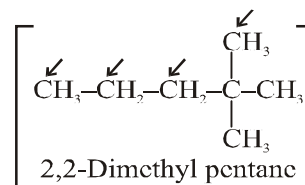
Only two isomeric monochloro derivatives are possible (excluding stereoisomer)

Position (1,4) – Identical

Position (2,3) – Identical



Only one monochloro derivative



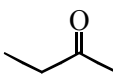
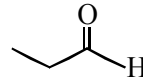
4 monochloro derivative possible (excluding stereoisomer)

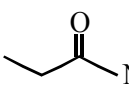
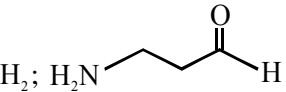
9. $\text{C}_4\text{H}_8 \Rightarrow \text{CH}_3 - \text{CH}_2 - \text{CH} = \text{CH}_2$ (1-butene)

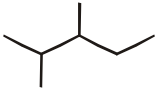
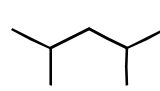
$\text{CH}_3 - \text{CH} = \text{CH} - \text{CH}_3$ (2-Butene)

$\text{CH}_3 - \text{C}(\text{CH}_3) = \text{CH}_2$ (Isobutene)

(3 structural isomers)

10.  ; 
are not isomer (Molecular formula differ)

 ; 
are functional isomer (Not position isomer)

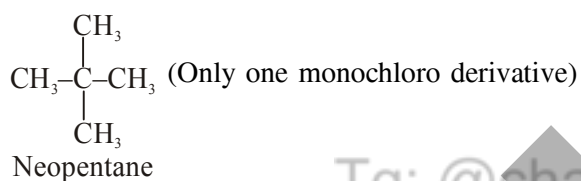
 ; 
(2,3-Dimethylpentane) (2,4-Dimethylpentane)
are position isomers

11. Molecular mass of hydrocarbon = 72

$$14n + 2 = 72 \text{ (Alkane)}$$

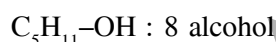
$$(n=5)$$

n = number of carbon in branched chain isomer of hydrocarbon

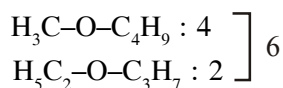


12. $C_5H_{12}O$:
Represent either alcohol or ether)

1. Alcohol :

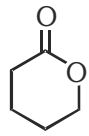
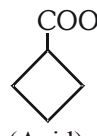


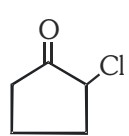
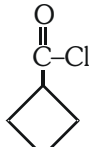
2. Ether :

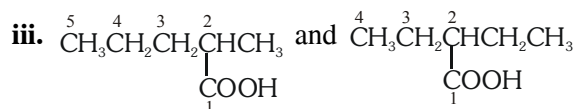


$$[\text{Total} : 8 + 6 = 14]$$

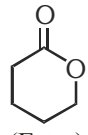
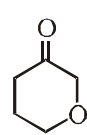
13. Relation between the following compounds:

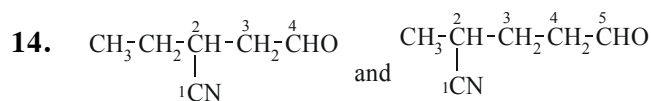
i.  and  are functional
(Ester) (Acid)
isomers.

ii.  and  are functional
(Ketone) (Acid chloride)
isomers.



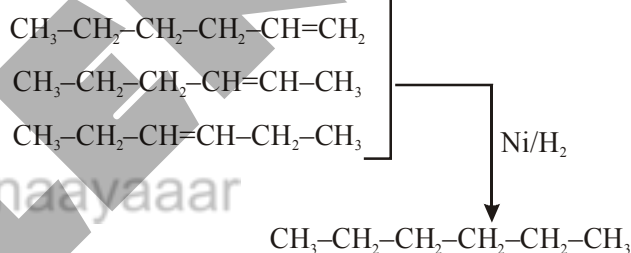
are chain isomers.

iv.  and  are functional
(Ester) (Ether containing ketone)
isomers.

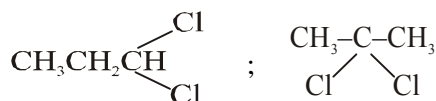


are Chain isomers.

15. C_6H_{12} : (Structural isomeric alkene of unbranched alkene = 3)

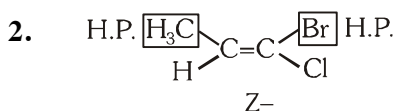
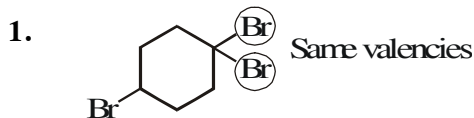


16. $C_3H_6Cl_2$; Geminal dihalide

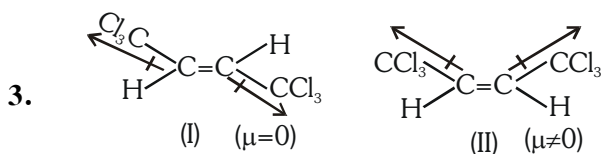
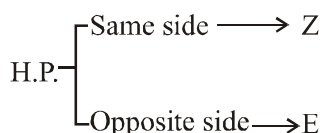


GEOMETRICAL ISOMERISM

RACE # 03



H.P. : Higher priority according to CIP rule



Dipole moment :

II > I (Additive moment vector in II)

Boiling moment :

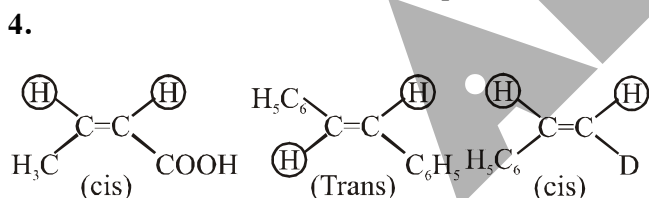
II > I (II is more polar)

Melting point :

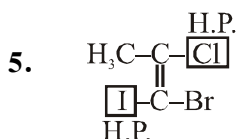
I > II (I is symmetrical, more packing)

Stability :

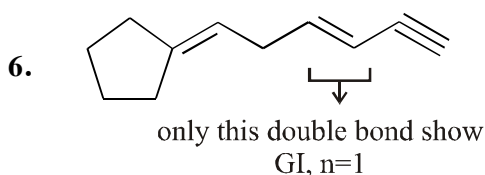
I > II (In I, less steric repulsion)



In across double, each sp^2 carbon should have at least one identical group, then show cis-trans isomerism. (Note: For GI, each sp^2 carbon should have two different group)

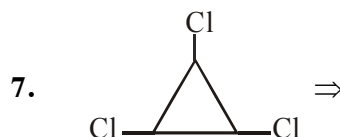


Highest priority (H.P) at opposite side :- E

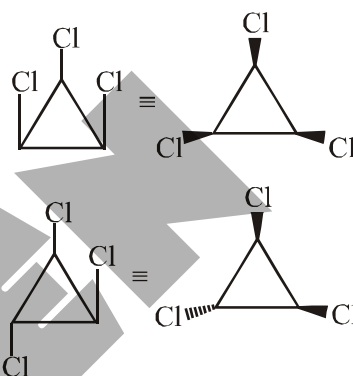


No. of GI = 2^n (For unsymmetrical alkene)
 n = no. of double bond, across which molecule show GI.

$$2^1 = 2 < \begin{matrix} \text{Cis} \\ \text{Trans} \end{matrix}$$



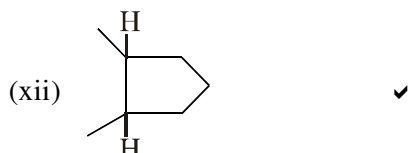
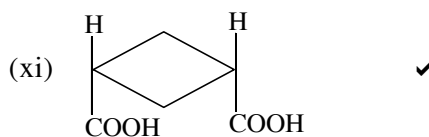
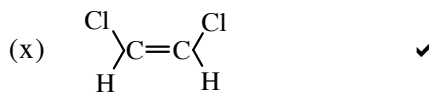
(only two different configurational GI)



8. The comp. which can show GI are :-
Note :-

- (I) To show GI in alkene ; each sp^2 carbon should have two different group.
(II) To show GI in cycloalkane ; At least two different carbon atom of cycle should have two different group.

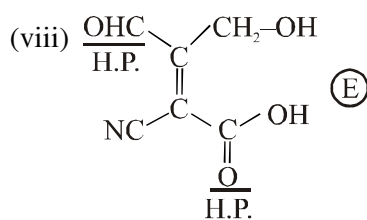
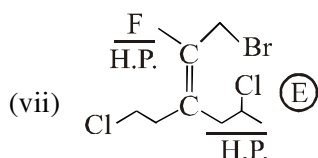
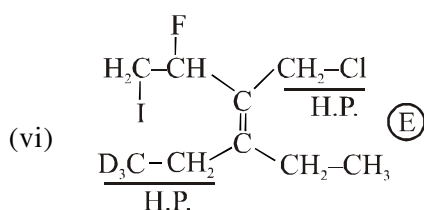
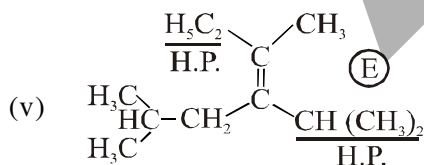
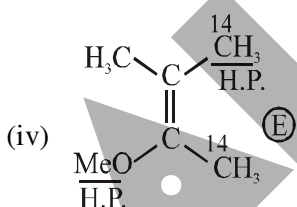
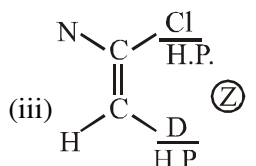
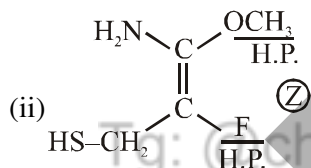
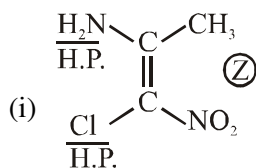
- | | GI |
|---|---------------------------------|
| (i) $\text{CH}_3-\text{CH}=\text{CH}-\text{C}\equiv\text{CH}$ | ✓ |
| (ii) $\text{CH}_3-\underset{\text{H}}{\text{C}}=\text{N}-\text{OH}$ | ✓ |
| (iii) $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}=\text{CH}_2$ | × |
| (iv) $\text{CH}_3-\text{CH}=\text{CHCl}$ | ✓ |
| (v) $\text{CH}_3-\text{CH}=\underset{\text{CH}_3}{\text{C}}-\text{CH}_3$ | × |
| (vi) $\text{CH}_3-\text{C}\equiv\text{C}-\text{CH}_3$ | × |
| (vii) $\text{CH}_3-\text{CH}_2-\underset{\text{Cl}}{\text{CH}}-\text{CH}_3$ | × |
| | (Linear) |
| | (No restricted rotation system) |
| (viii) $\text{CH}_2=\text{CH}-\text{C}\equiv\text{CH}$ | × |
| (ix) $\text{CH}_3-\text{CH}=\text{CH}-\text{CH}_3$ | ✓ |



9. E/Z configuration :

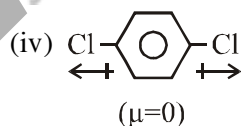
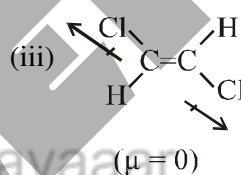
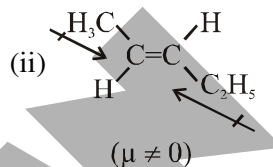
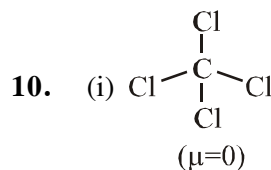
Note : Each sp^2 carbon should have two different group to show GI.

- (I) High priority (HP) gp. at opposite side :- E
(II) High priority (HP) gp. at same side :- Z

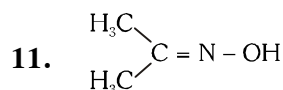


Z :- (i), (ii), (iii)

E :- (iv), (v), (vi), (vii), (viii)

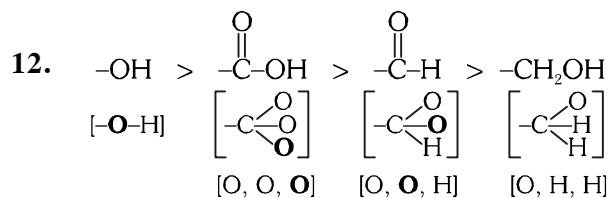


((i), (iii), (iv) show zero dipole moment)

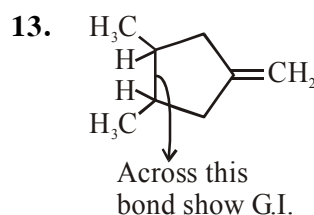


(Not show G.I.)

(sp^2 carbon should have two different groups.)

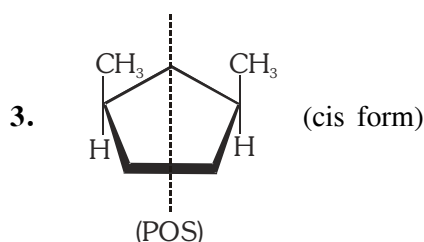
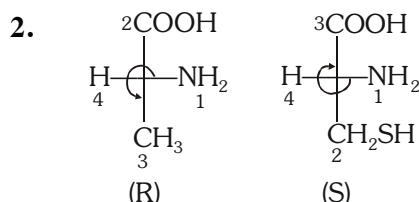
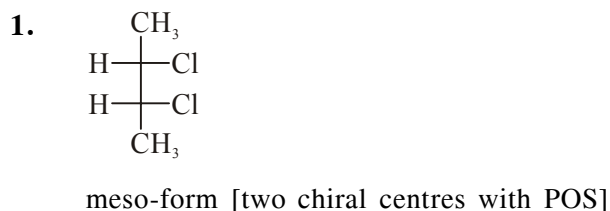


[Priority according to CIP rule]



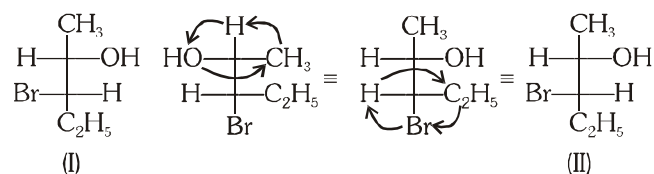
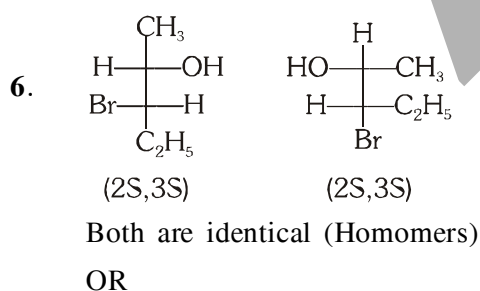
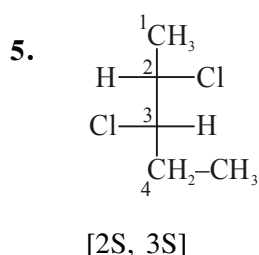
OPTICAL ISOMERISM

RACE # 04

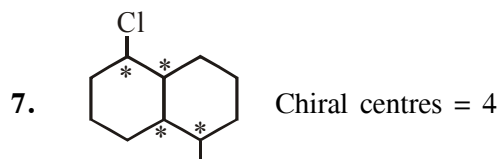


Optically inactive due to plane of symmetry)

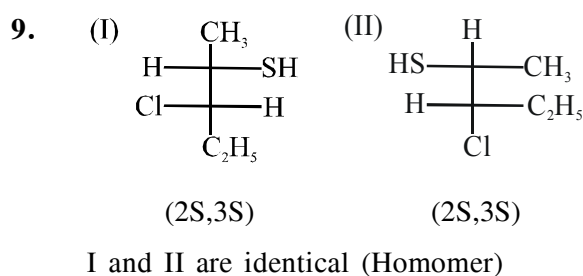
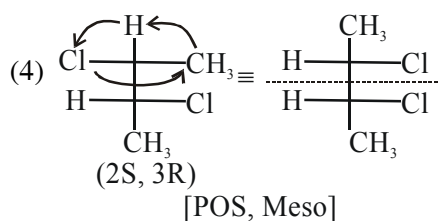
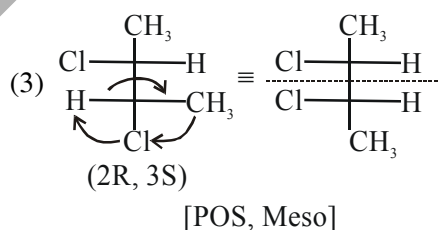
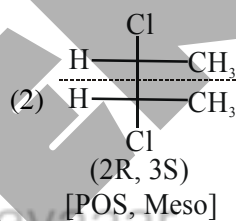
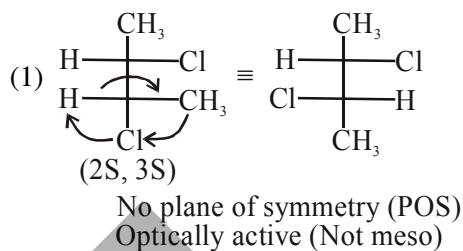
4. A-R, B-Q, C-S, D-P

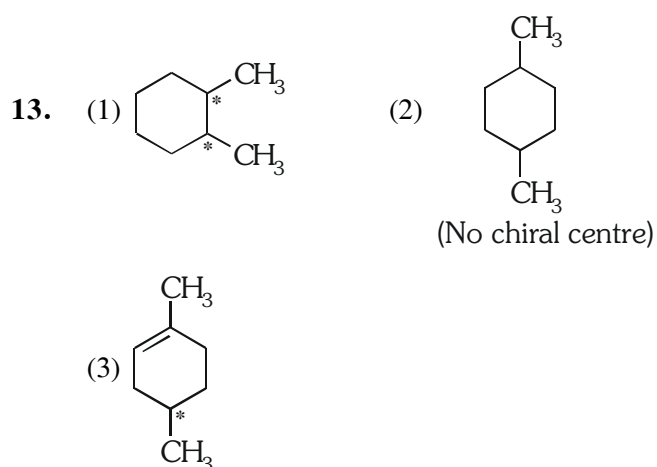
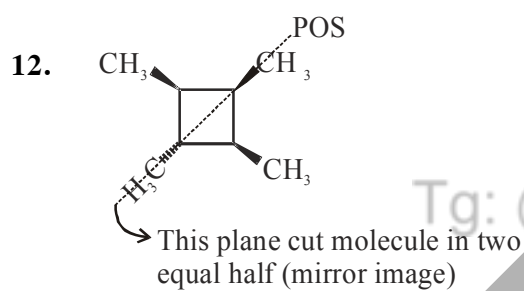
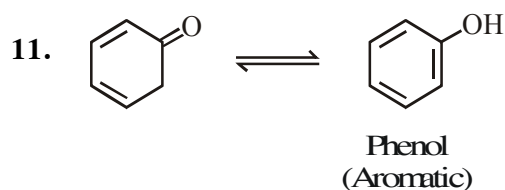
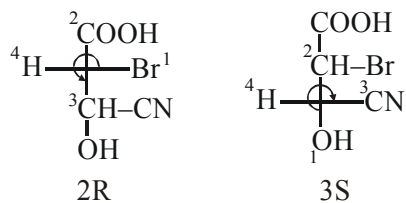
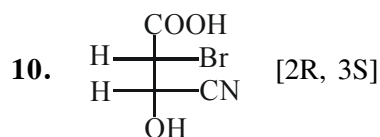


If we rotate 3 group/atom by fixing one valency then no change in configuration. I and II are identical (Homomers).



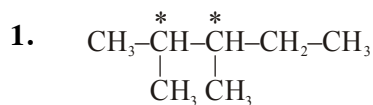
8. If we rotate 3 group/atom by fixing one valency then no change in configuration.



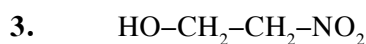
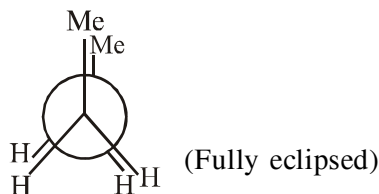


ISOMERISM (COMPLETE)

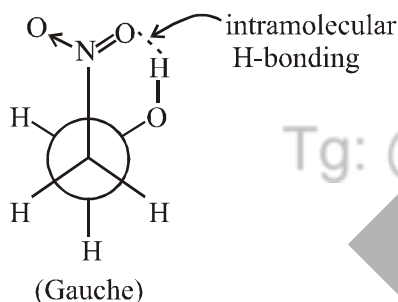
RACE # 05



2. Fully eclipsed form of n-Butane have maximum repulsion, hence highest energy and least stability.

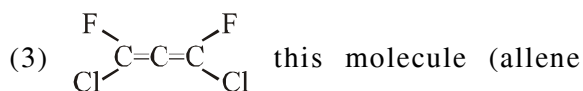


(Gauche is more stable due to intramolecular H-bonding)



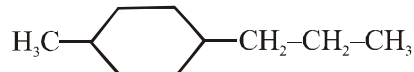
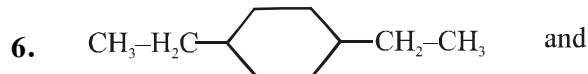
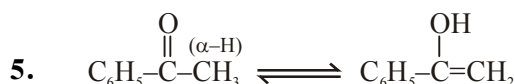
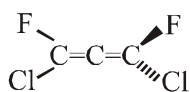
4. All statement are true

(2) Compound having one chiral-C, never a meso compound, because net rotation towards PPL never zero



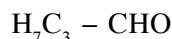
is optically active due to chiral molecule.

(Both valency are perpendicular)



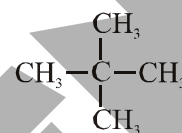
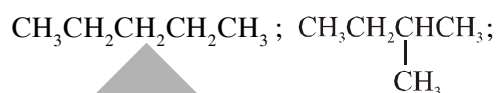
are Chain Isomers.

7. (a) $\text{C}_4\text{H}_8\text{O}$:



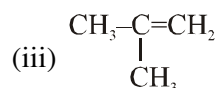
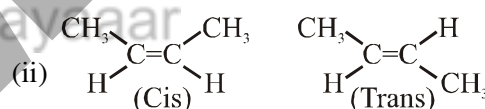
$\Rightarrow$ 2 aldehyde (monovalent radical of $\text{C}_3\text{H}_8 = 2$)_(x)

(b) C_5H_{12} : No. of chain isomers = 3_(y)

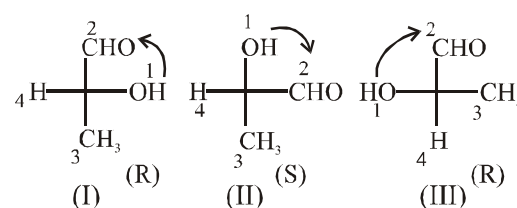


(c) C_4H_8 :- Maximum no. of alkenes $\Rightarrow 4$ _(z)

(i) $\text{CH}_3-\text{CH}_2-\text{CH}=\text{CH}_2$



Hence $X + Y + Z \Rightarrow 2 + 3 + 4 = 9$

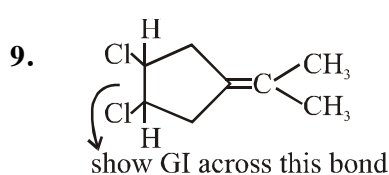


(1) Equimolar mixture of I and II are racemic mixture (optically inactive due to external compensation).

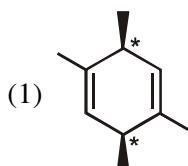
(2) II and III are enantiomer, so different behaviour towards PPL.

(3) II & III are enantiomer (not identical).

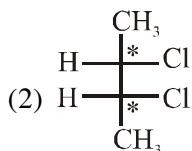
(4) Enantiomer (I and II) have same physical property eg MP, BP, viscosity etc. except rotation of PPL, so they are not separated by fractional distillation.



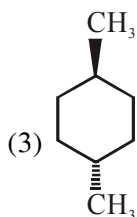
10. Which of following compound is chiral



"No POS" (Chiral molecule)



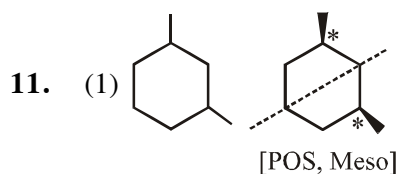
POS (Achiral molecule)



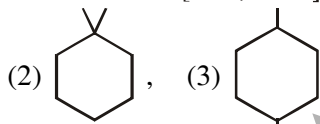
No chiral centre
(Optically inactive)



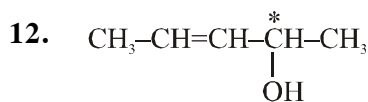
POS
(Achiral molecule)



[POS, Meso]

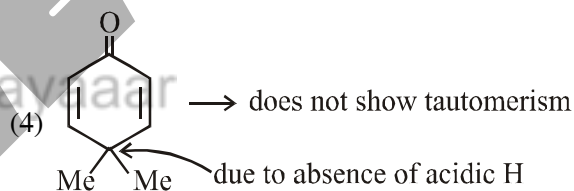
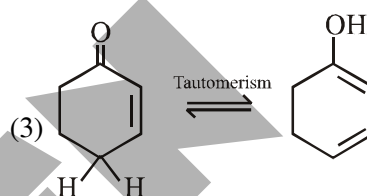
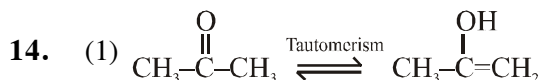
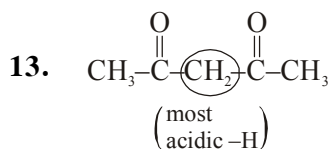


No chiral centre in (2) and (3)



No. of stereocentre = 2

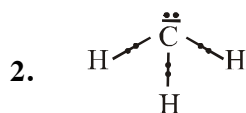
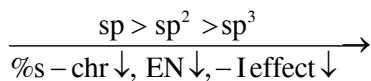
No. of stereoisomer $\Rightarrow 2^n = 2^2 = 4$



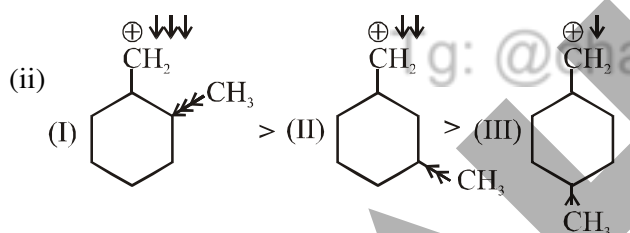
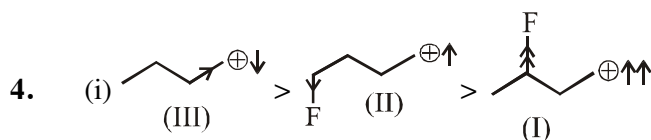
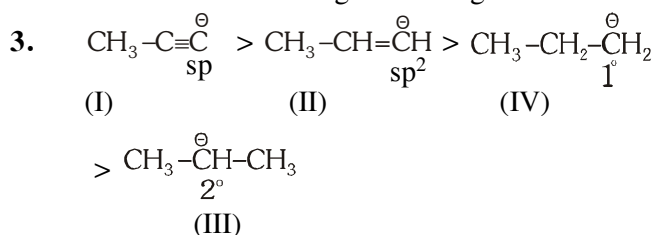
ELECTRONIC DISPLACEMENT

RACE # 06

1. $[-I \text{ effect} \propto \text{EN} \propto \% \text{ s-character}]$
as $\% \text{ s character}$ increases, EN also increases

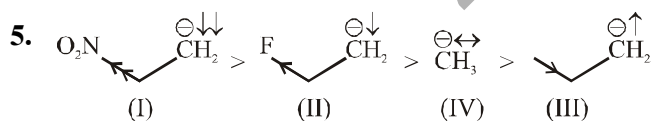


8 electron is present in valency shell of carbon of carbanion bearing $-ve$ charge.



Stability of carbocation $\propto$ EDG (electron donating gp)

$$\propto \frac{1}{\text{EWG (electron withdrawing gp)}}$$



Stability of carbanion $\propto$ EWG

$$\propto \frac{1}{\text{EDG}}$$

6. Acidic strength $\propto [\text{H}^+]$
(AS) $\propto K_a$

$$\propto \frac{1}{p_{K_a}}$$

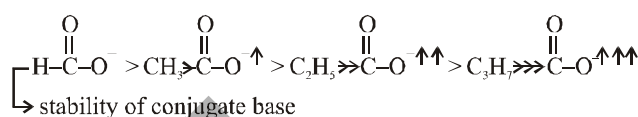
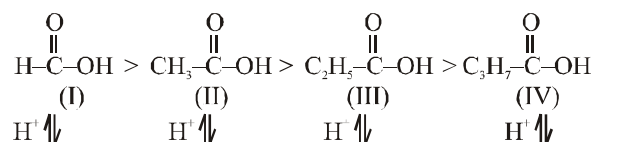
$\propto$ stability of conjugate base

$\propto$ EWG

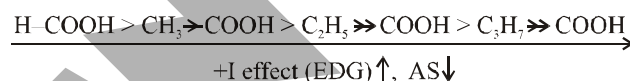
$$\propto \frac{1}{\text{EDG}}$$

$\rightarrow$ decreasing order of K_a means decreasing order of acidic strength.

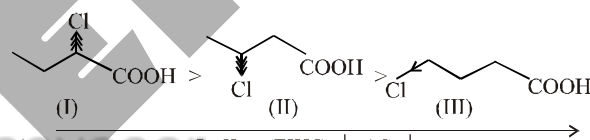
(i)



or

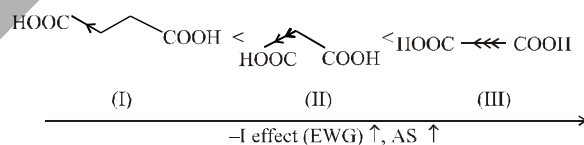


(ii)

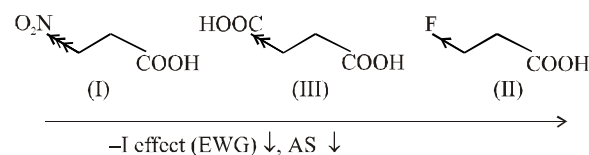


$-I \text{ effect (EWG)} \downarrow, \text{AS} \downarrow$

(iii)



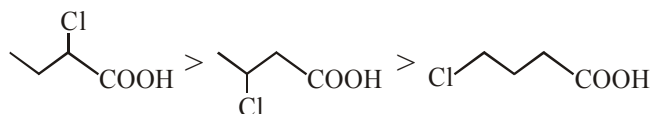
(iv)



$-I \text{ effect (EWG)} \downarrow, \text{AS} \downarrow$

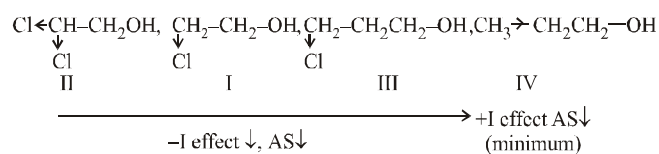
7. Acidic strength $\propto K_a \propto \frac{1}{p_{K_a}}$

(Lowest p_{K_a} means more acidic) $\Rightarrow$ Highest K_a

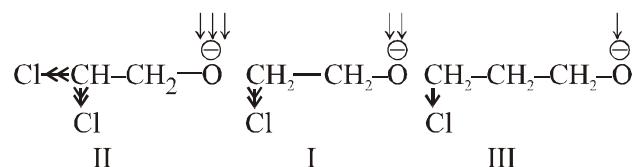


Max $-I$ of $-\text{Cl}$ group

8. Acidic strength (AS) order :



OR

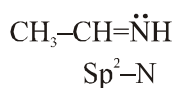
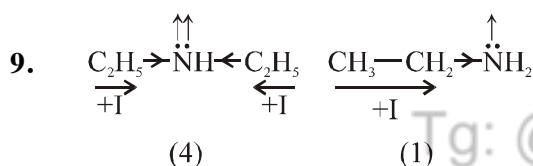


IV

Stability of conjugate base II > I > III > IV

AS $\propto$ Stability of conjugate base

so AS :- II > I > III > IV

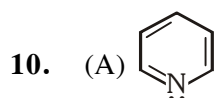


(2)

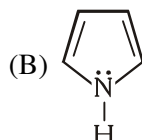
Basic strength (BS) $\propto$ EDG (electron donating gp)

$$\propto \frac{1}{\text{EWG (electron withdrawing gp)}}$$

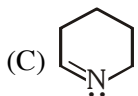
$$\propto \frac{1}{\text{EN}}$$



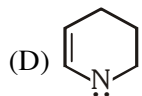
(localised lp)



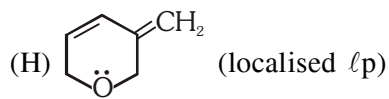
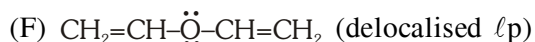
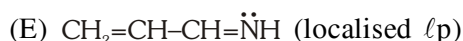
(delocalised lp)



(localised lp)



(delocalised lp)

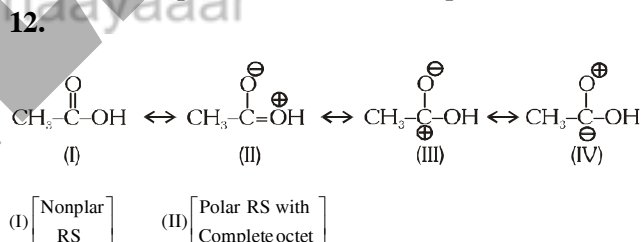
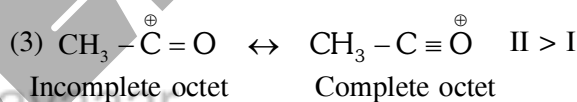
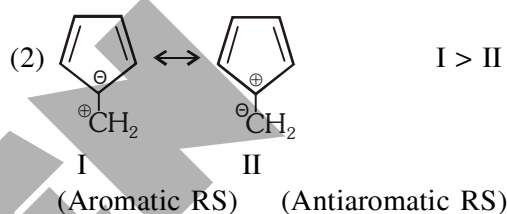
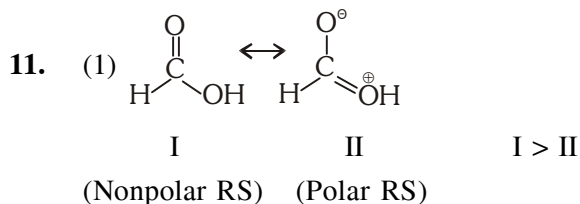


(localised lp)



(delocalised lp)

Delocalised lp (B, D, F, I) takes part in resonance.
(Which are alternate to π -bond)



III and IV :-

[Polar RS with incomplete octet]

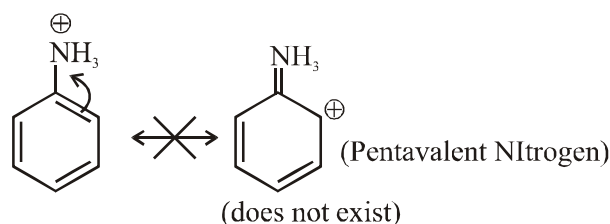
(a) +ve on less EN and -ve on more EN atom more stable.

(b) +ve on more EN and -ve on less EN atom less stable.

Order :-

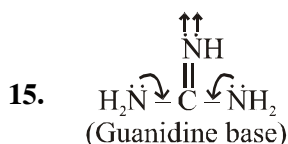
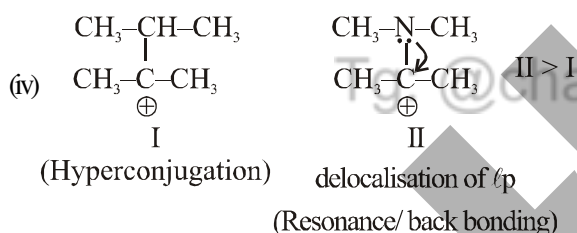
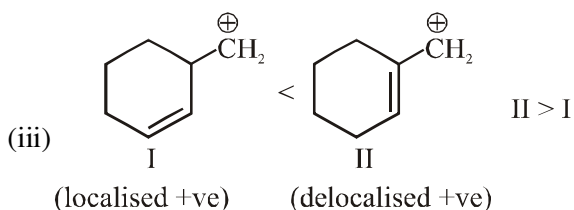
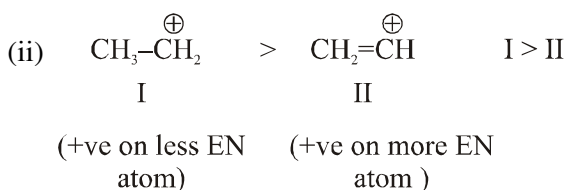
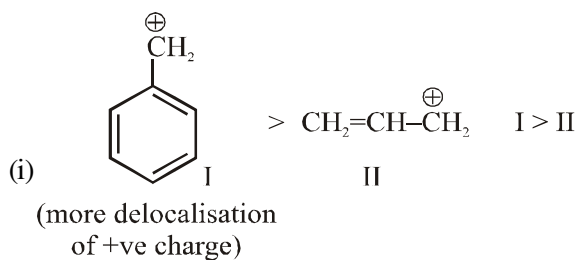
I > II > III > IV (stability)

13.



No resonance effect of $-\text{NH}_3^+$ group.

14. Stability order :-

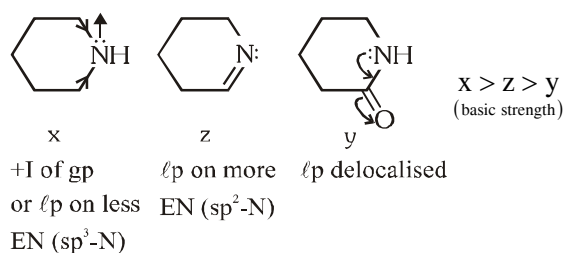


Due to + M of -NH₂ and less EN of 'N' than 'O', more basic as compare to (1)

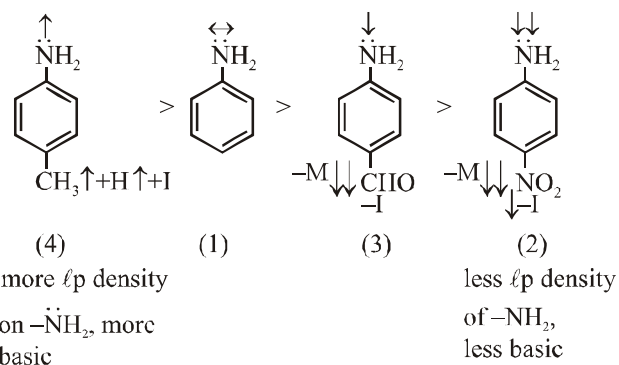
Note :-

*Conjugate acid show equivalent resonating structure, more stable conjugate acid.

16. Basic strength :



17.



Basic strength $\propto$ EDG

$$\propto \frac{1}{\text{EWG}}$$

18.



- cyclic
- planar
- cyclic resonance
- follow Huckel's Rule

$[(4n + \pi) e^- \text{ system; } n = 0, 1, 2, \dots]$

$$4n + 2 = 6$$

$$4n = 4 : \boxed{n=1}$$

- Aromatic

19.



- cyclic
- planar
- cyclic resonance
- follow Huckel's Rule

$[(4n + \pi) e^- \text{ system; } n = 0, 1, 2, \dots]$

$$4n+2 = 2; \boxed{n=0}$$

- Aromatic

20.



- cyclic
- planar
- cyclic resonance
- follow

$[(4n\pi) e^- \text{ system; } n = 1, 2, 3 \dots]$

$$4n = 4 \quad [n=1]$$

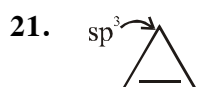
• Antiaromatic



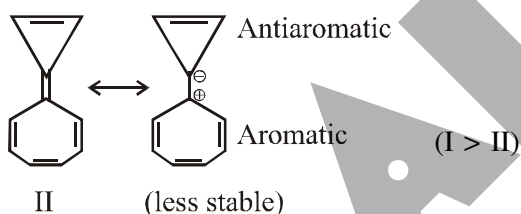
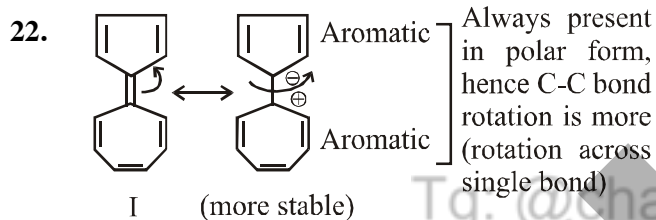
This is non aromatic.



(Tub shaped, non planar).



- cyclic
- Nonplanar (sp^3 carbon)
- Non aromatic

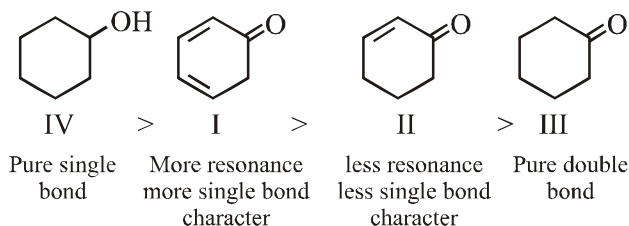


23. Bond length :

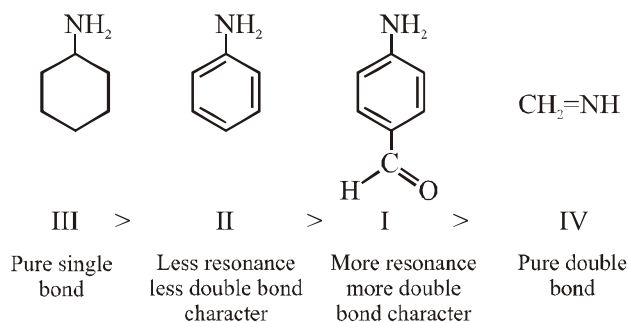
[Single bond > partial double bond > double bond > triple bond]

* Resonance increases double bond character in single bond and single bond character in double bond.

(a) C-O bond length :

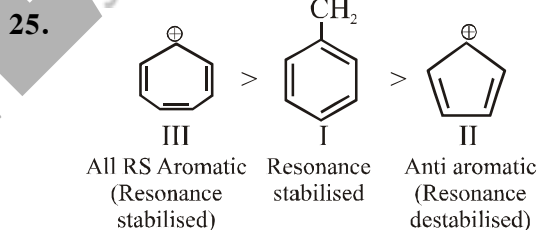
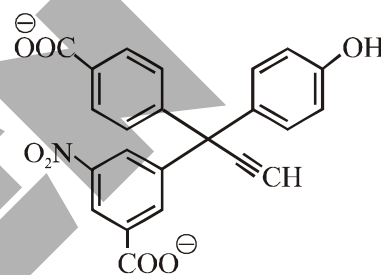


(b) C-N bond length :



24. The more acidic group give fast acid-base reaction followed by less acidic group.

Since only 2 moles of NaNH_2 is taken so the most acidic $-\text{COOH}$ group (two in number) only give acid-base reaction.

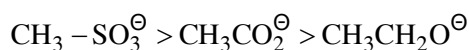


26. $-\text{CH}_3$ show maximum hyperconjugation effect but minimum inductive inductive effect.

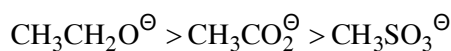
For Hyperconjugation :- C-H bond energy should be low (more α -H more hyper conjugation with less C-H bond energy)

For Inductive Effect :- no. of carbon and branching increases inductive effect.

28. Stability of $(-)$ charge :



BS of conjugate base :

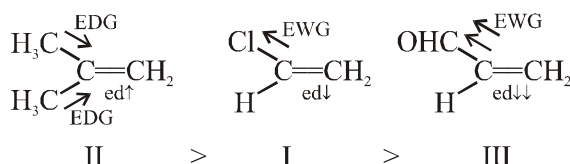


REACTION MECHANISM (PART-II)

RACE # 07

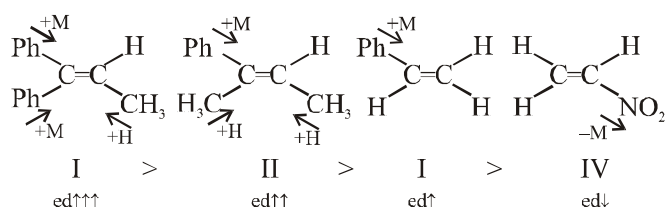
1. Hydrochlorination (HCl) is an electrophilic addition reaction on alkene.
Reactivity towards EAR $\propto$ Nucleophilicity of alkene or π -bond.

(ed $\Rightarrow$ electron density)

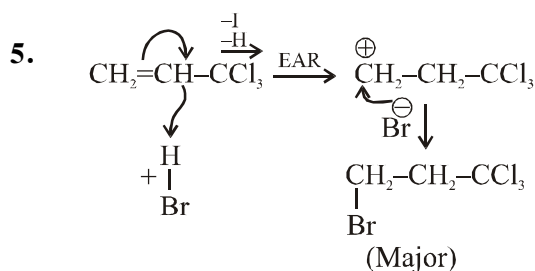
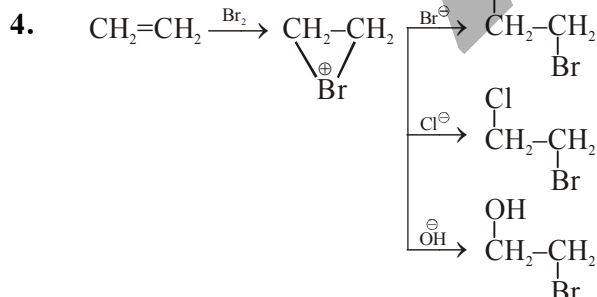
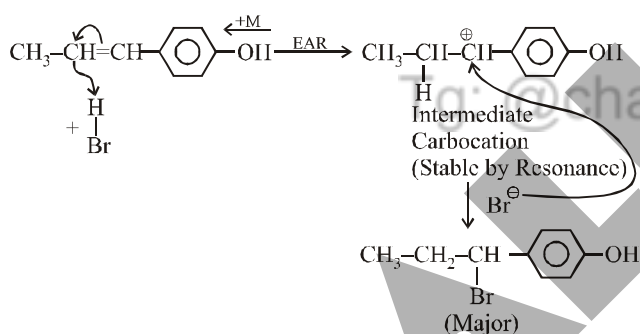


2. Reactivity towards EAR $\propto$ Nucleophilicity of π -bond

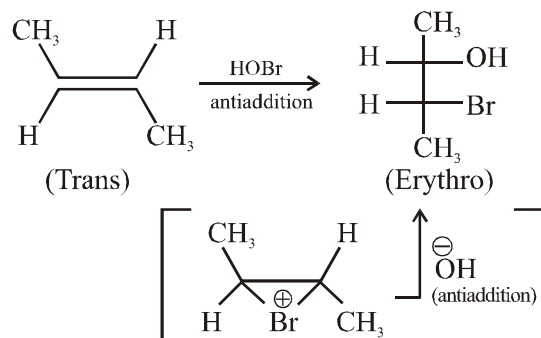
(ed $\Rightarrow$ electron density)



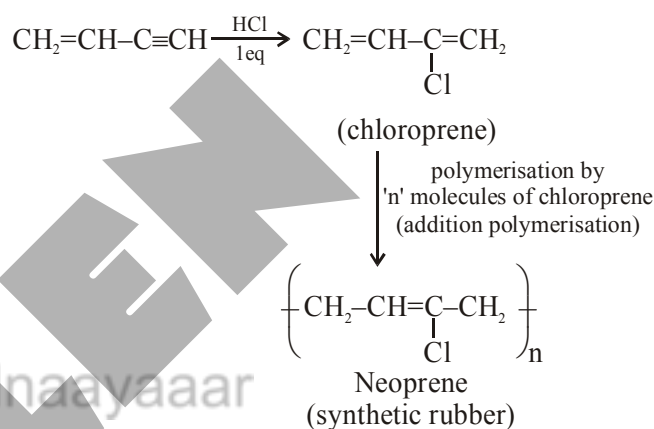
- 3.



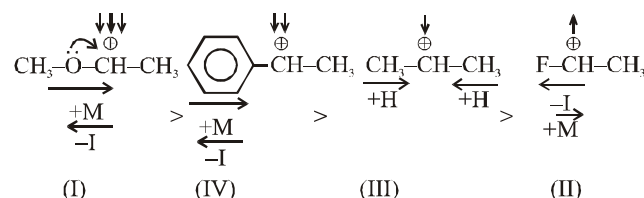
- 6.



- 7.

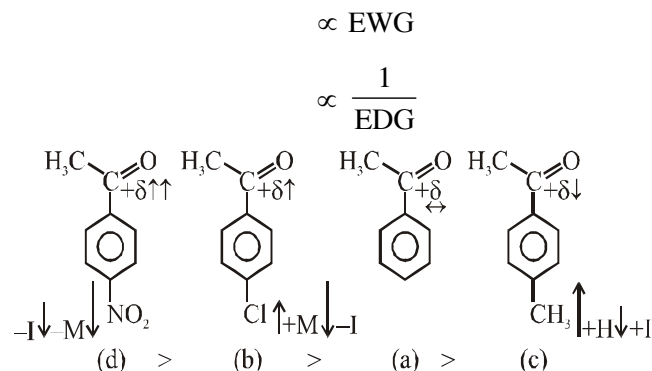


8. Reactivity for hydration $\propto$ stability of carbocation

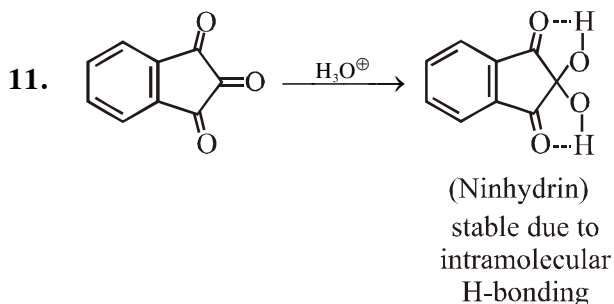
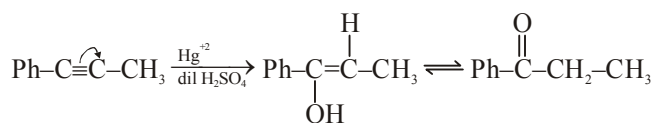


Reactivity towards hydration : I > IV > III > II

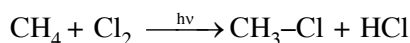
9. Reactivity of NAR $\propto$ +ve charge on sp^2 carbon (Keg for NAR)



10.

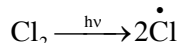


12. (Free radical chlorination of methane)
⇒ FRSR

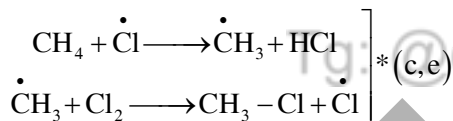


Mechanism :-

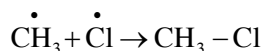
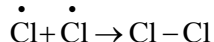
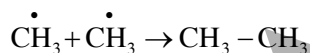
(i) Chain Initiation :-



(ii) Chain Propagation



(iii) Chain Termination

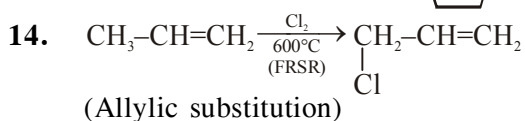
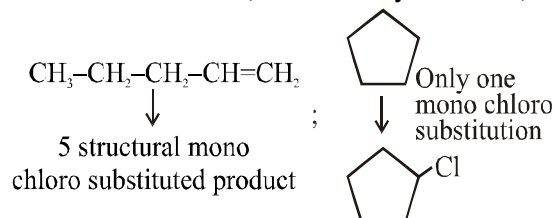


13. Hydrocarbon X; (V.D. = 35)

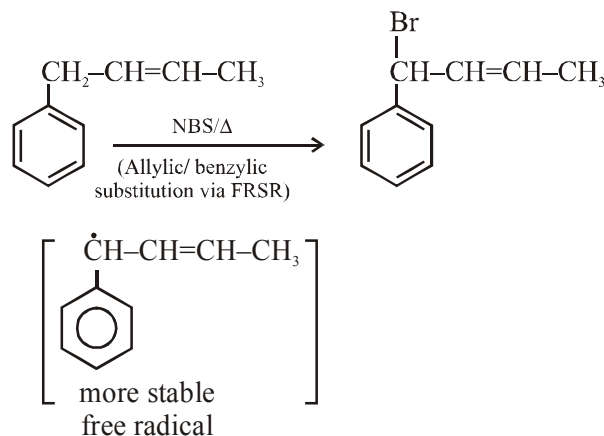
Mo.Wt. = $2 \times \text{V.D.}$

$$= 2 \times 35 = 70$$

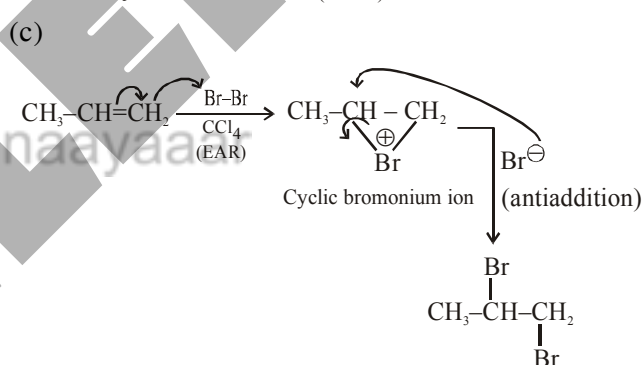
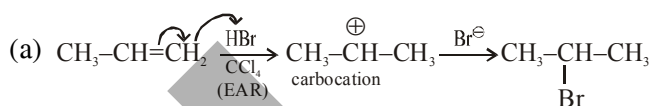
$$14n = 70 : n = 5 \quad (\text{Alkene or cycloalkane})$$



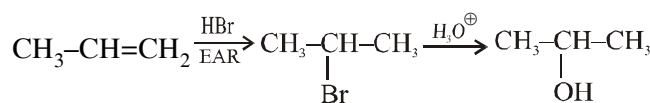
15.



16.



(d)

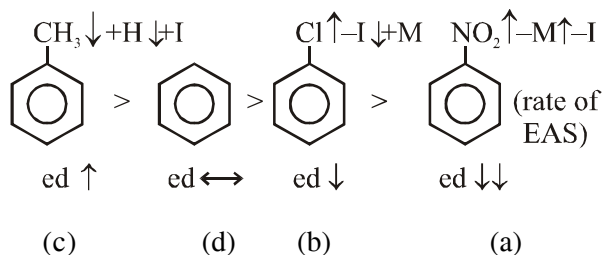


- $\left[\begin{array}{l} \text{a - s} \\ \text{b - r} \\ \text{c - q} \\ \text{d - p} \end{array} \right]$

REACTION MECHANISM (PART-II)

RACE # 08

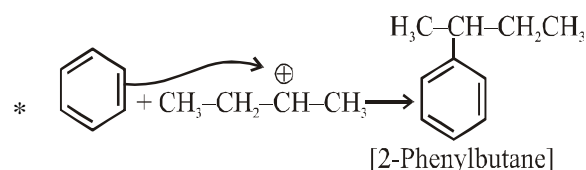
1. Rate of EAS $\propto$ Nucleophilicity of aromatic ring
 $\propto$ EDG (electron donating group)
 $\propto \frac{1}{\text{EWG}}$ (electron withdrawing group)



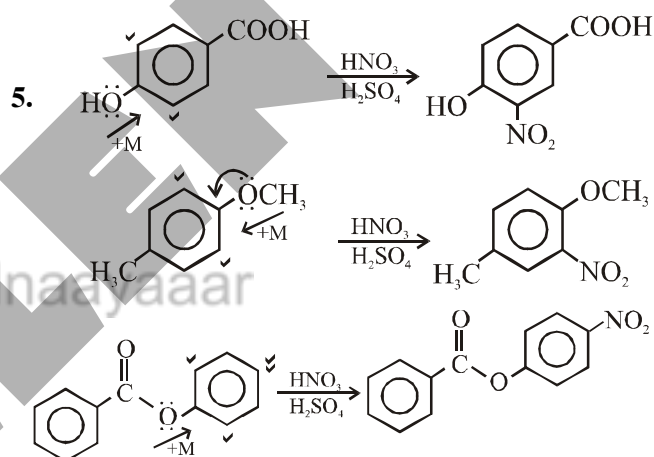
- 2.
- due to steric repulsion of group)
- $-\text{CH}_3$ is ortho/para directing and ring activating group.

3. 1.
- 2.

- 3.
- 4.

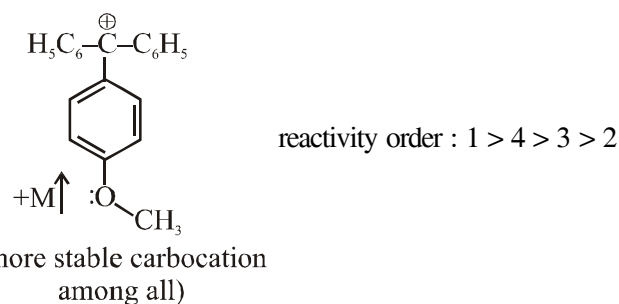


- 4.
- due to +M of $-\text{NH}-$ this ring is activated for ESR (ortho/para directing)

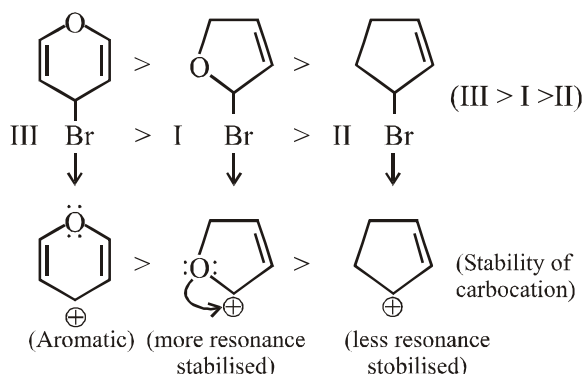


E^+ attack in most activated ring at most activated site, and at the place where minimum steric hinderance.

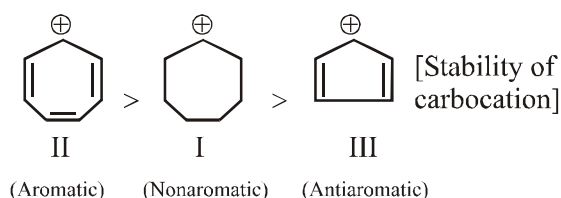
6. If alkyl group is same, then rate of $\text{S}_{\text{N}}2$ is directly proportional to leaving tendency of halide attached to alkyl group.
 $\text{R} - \text{I} > \text{R} - \text{Br} > \text{R} - \text{Cl} > \text{R} - \text{F}$
 (minimum bond energy)
7. Reactivity towards $\text{S}_{\text{N}}1 \propto$ stability of intermediate carbocation.



8. Reactivity towards $S_N1 \propto$ Stability of intermediate carbocation.



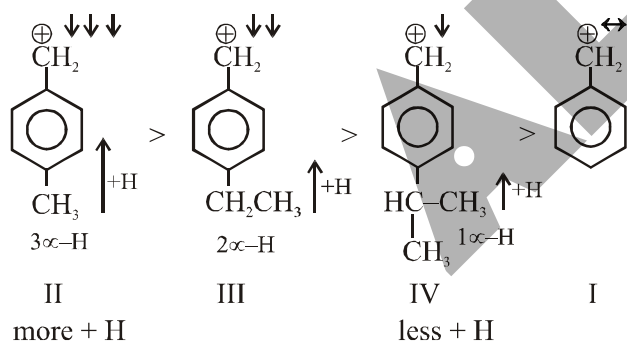
9. Reactivity towards $S_N1 \propto$ stability of intermediate carbocation



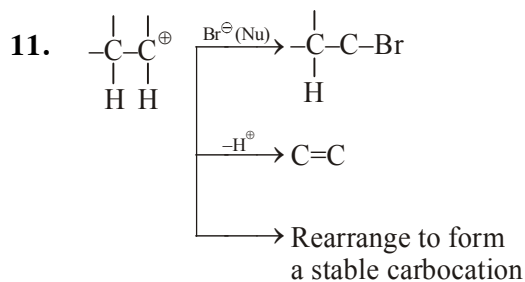
Rate of S_N1 of halide :- II > I > III

10. Reactivity towards $S_N1 \propto$ stability carbocation (intermediate)

Stability of carbocation :



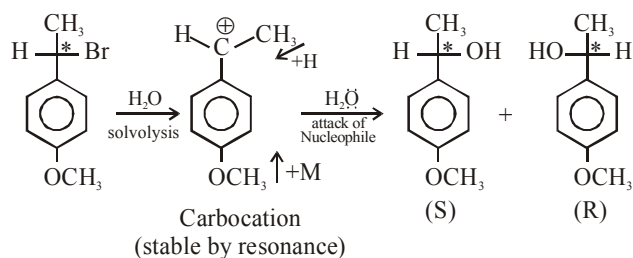
Reactivity of halide towards S_N1 :- II > III > IV > I



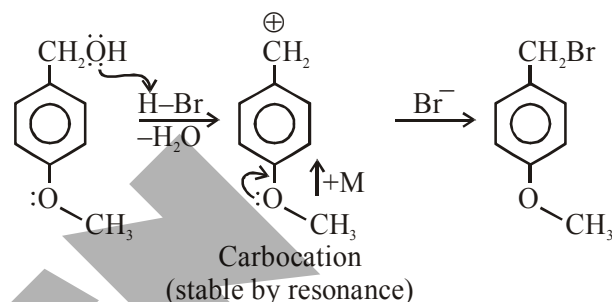
12. Solvolysis (Hydrolysis) produces carbocation (S_N1) as intermediate, so attack of $Nu^\ominus$ on both side of carbocation (planar : back side attack

slightly more) results in racemisation (partial racemisation) if chiral centre develop.

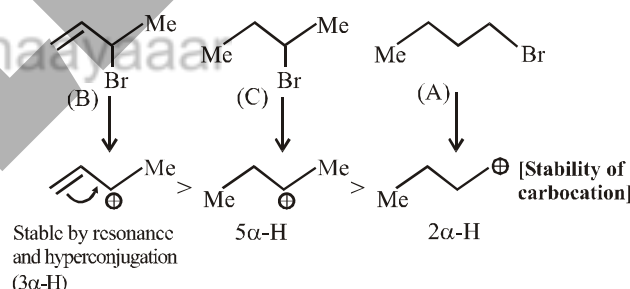
→ Reactivity towards $S_N1 \propto$ stability of carbocation.



- 13.



14. Reactivity towards $S_N1 \propto$ stability of intermediate carbocation



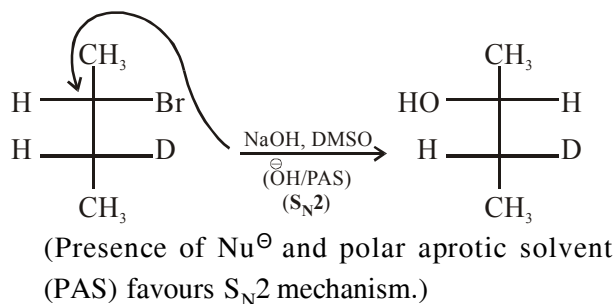
Reactivity towards S_N1 :- B > C > A

15. For S_N1 :-

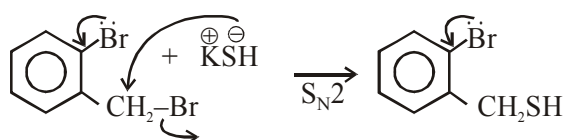
- True [Carbocation stability]
- False [Retained and Inverted both product obtained; Partial racemisation]
- True [Rate of $S_N1 \propto$ [substrate]]
- False [Rate not depends on conc. of $Nu^\ominus$]
- True [1st step is ionisation (RDS); 2nd step is attack of $Nu^\ominus$]
- True [Intermediate carbocation formed in S_N1]
- True [Rate of $S_N1 \propto$ [substrate alkyl halide]]
- True [rate of rxn depends on the nature of leaving group, more good leaving group, easily form carbocation]

True statement :- a, c, e, f, g, h

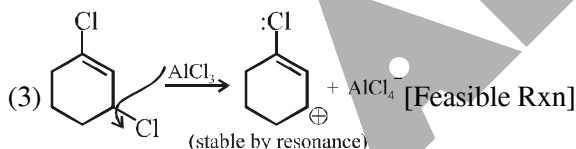
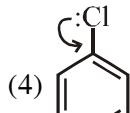
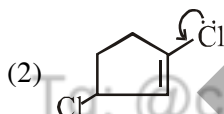
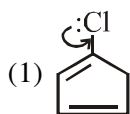
16.



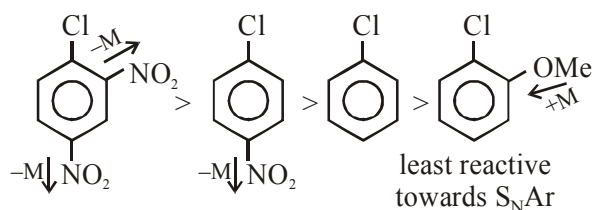
17. Partial double bond character, not show S_N (substitution nucleophilic) reaction at normal condition.



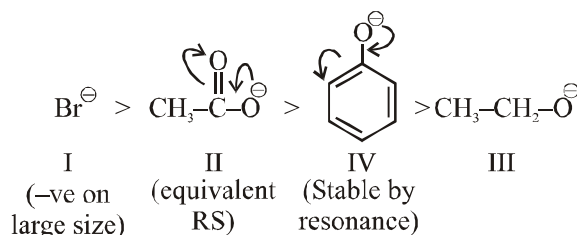
18. Partial double bond character, so bond (C-Cl) not easily break, also resulting carbocation is less stable (+ve on sp^2 carbon) in (1), (2) & (4)



19. Reactivity towards $\text{S}_\text{N}\text{Ar}$ (Nucleophilic aromatic substitution) $\propto$ EWG (electron withdrawing group); as intermediate carbanion formed.
* EWG at ortho/para position increases rate of reaction.

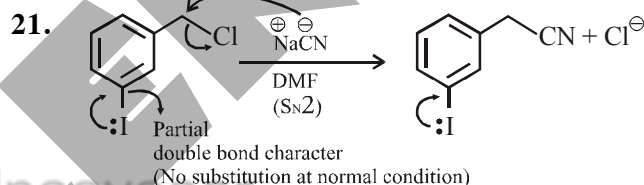
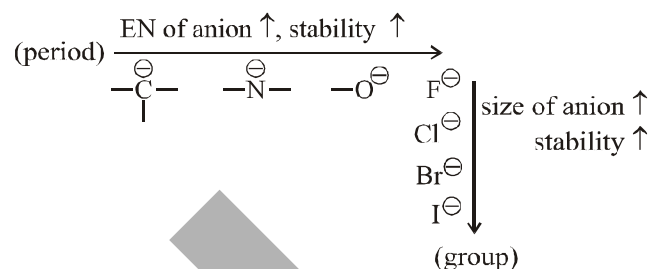


20. Leaving group tendency $\propto$ stability of anion

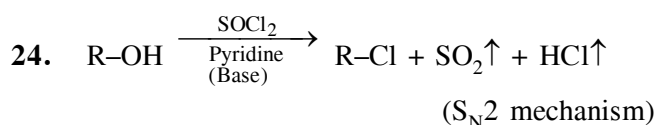
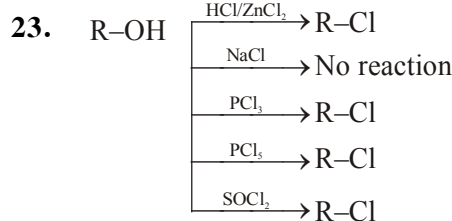
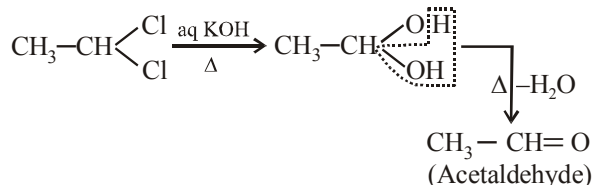


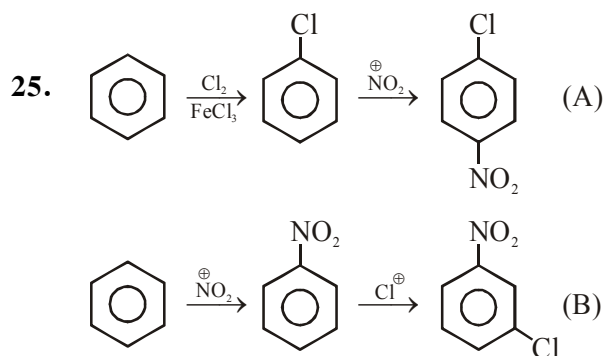
Leaving group tendency :- I > II > IV > III

Note :-



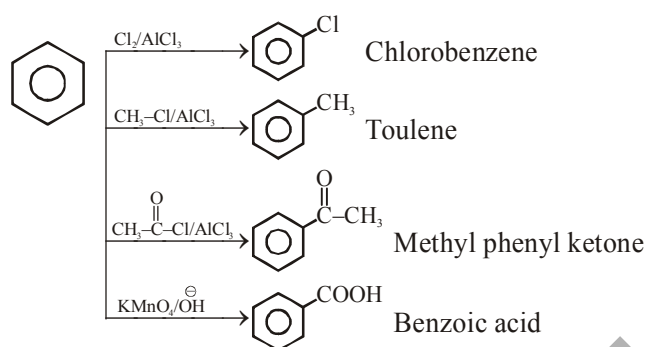
22.





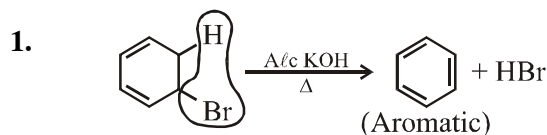
A and B are position isomers.

26.



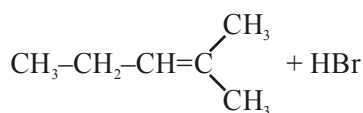
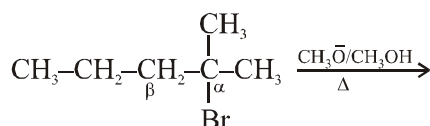
REACTION MECHANISM (PART-II)

RACE # 09



(Max. reactive for dehydrohalogenation)

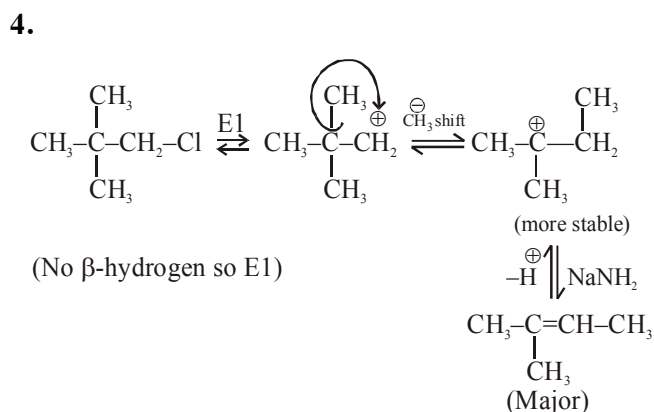
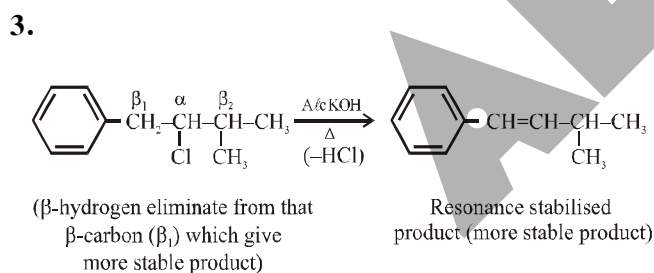
2. * $-F$, $-NR_3^+$ are poor leaving group, so generally give Hofmann elimination product. (partial carbanion character in transition state).
* Pyrolysis of ester also produce Hofmann elimination product.



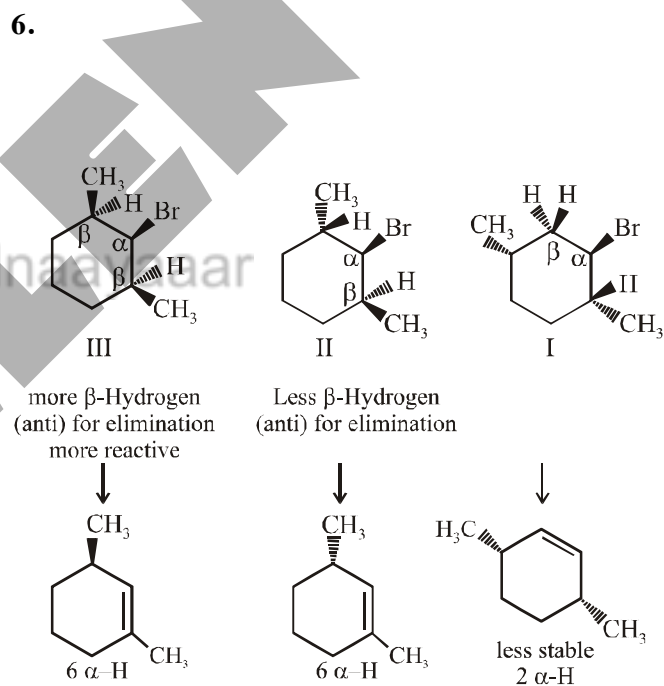
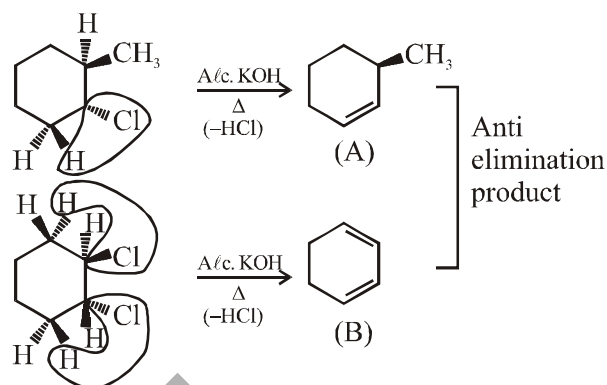
(Saytzeff's alkene)

(8 α -H)

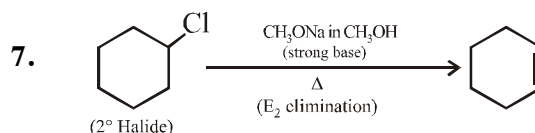
*(Highly substituted alkene is major product)
(more stable alkene)



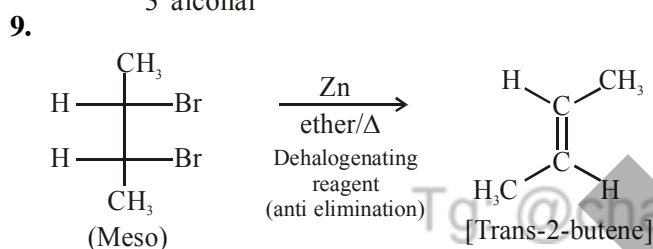
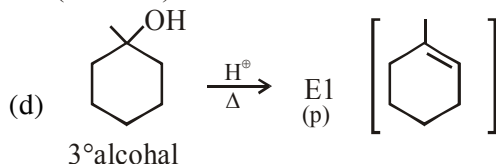
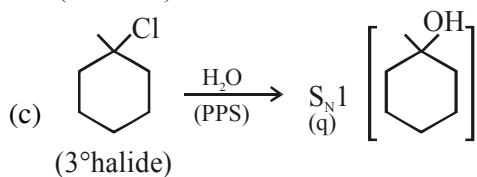
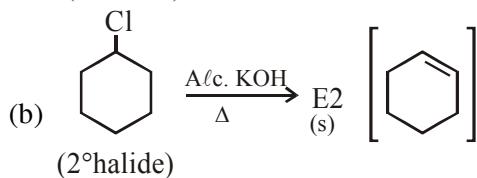
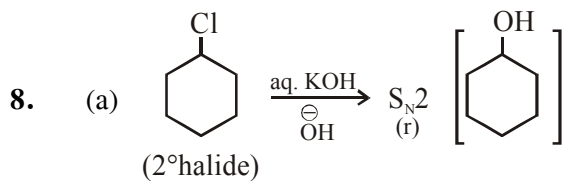
5. Alc. KOH is dehydrohalogenating reagent and follow antielimination of H and X.



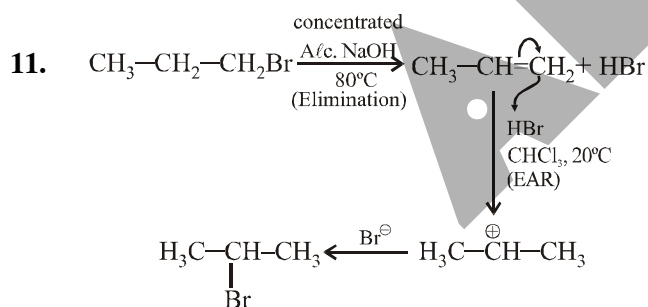
Reactivity order :- III > II > I



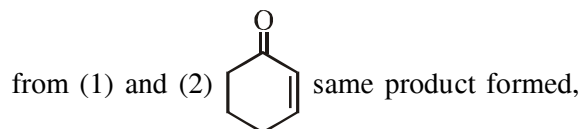
High temperature favours elimination.



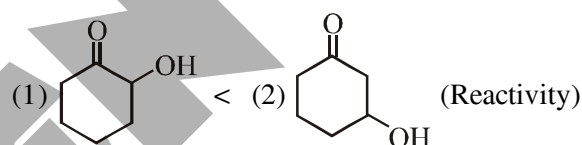
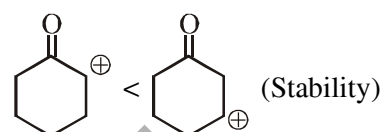
10. Hofmann's rule :- The double bond goes mainly towards the least substituted carbon.



12. Dehydration reaction is reversible controlled by thermodynamics, so more stable product is major (alkene)

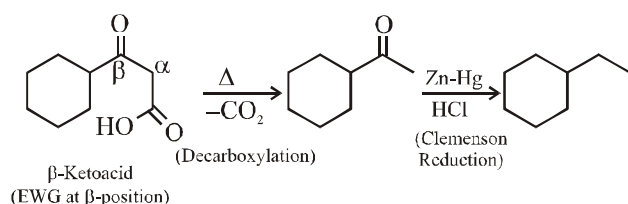


so now compare stability of carbocation formed.

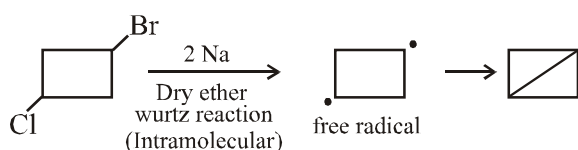


13. Rate of reaction for E_1
 $\propto [\text{alkyl halide}]^1 [\text{Base}]^0$

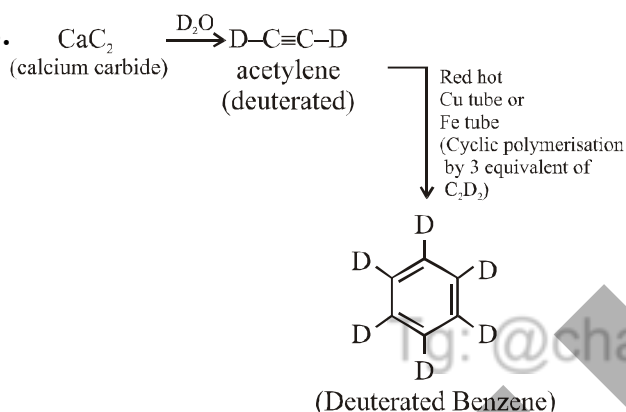
1.



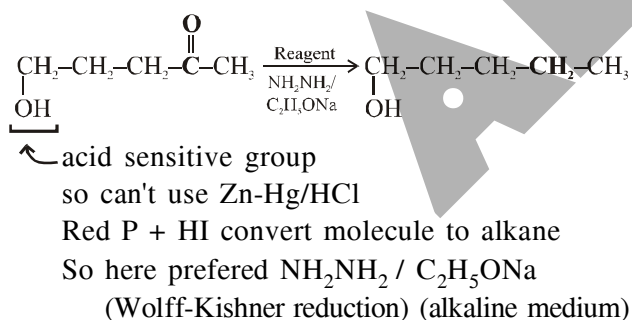
2.



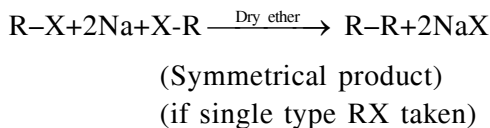
3.



4.

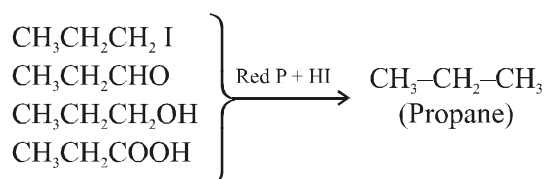


5.



6.

Red P + HI is strong reducing agent :- Final product is alkane.



7. Decolourisation of cold, dilute alkaline KMnO_4

(Bayer's reagent) is a test of unsaturation.

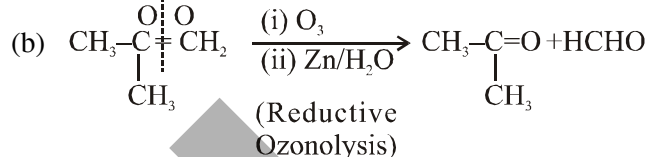
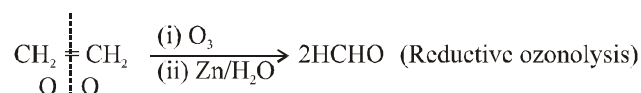
Benzene doesn't give test of unsaturation

(Aromaticity loss)

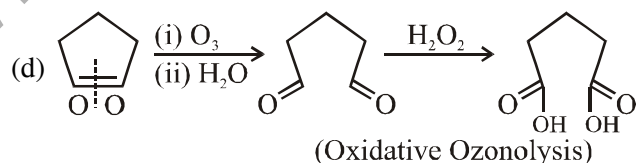
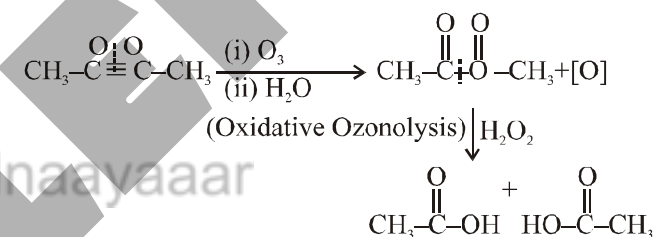
C_6H_{12} (alkene) give test of unsaturation.

8. Product of following rxn

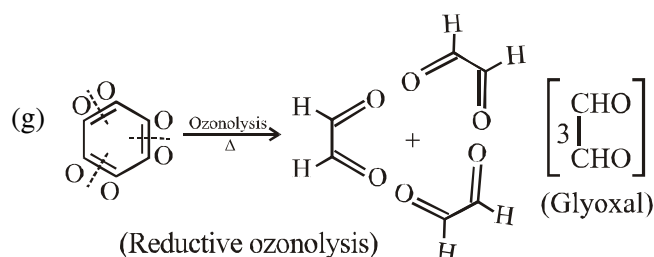
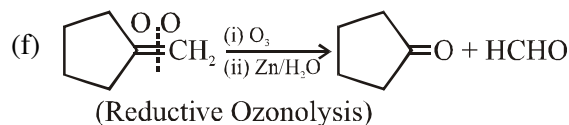
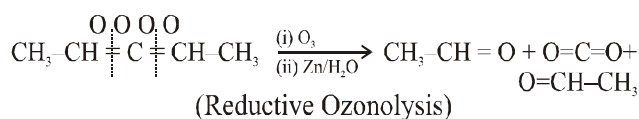
(a)



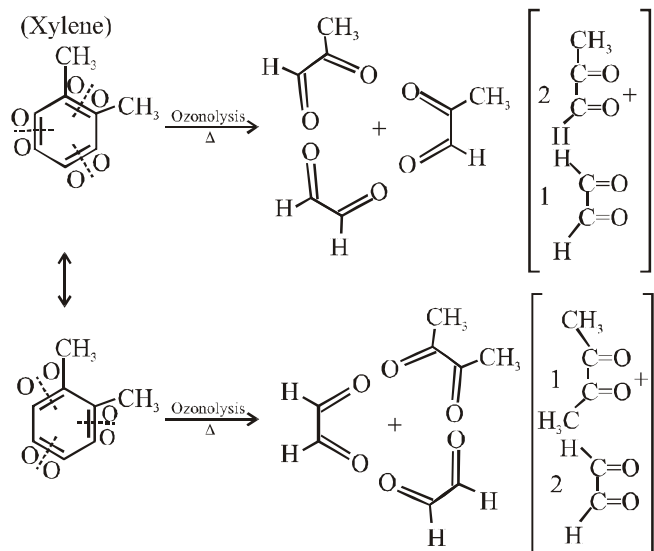
(c)



(e)

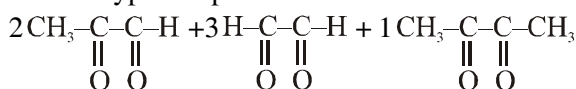


(h)

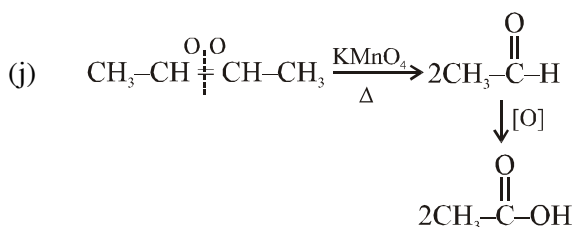
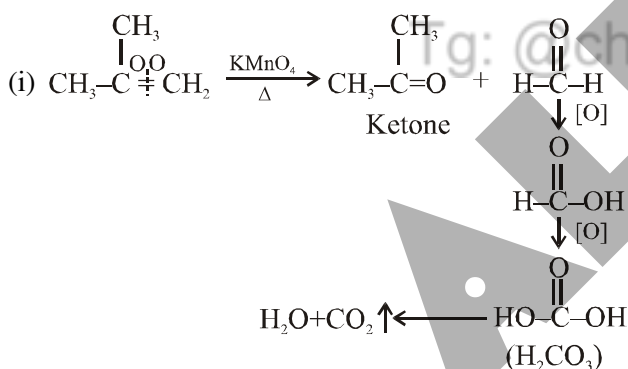


Note :-

Total 3 types of product

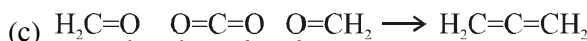
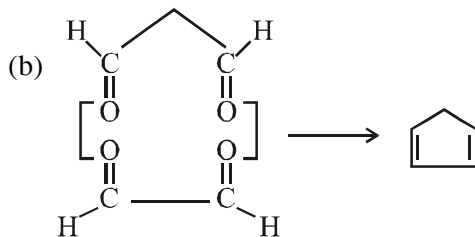
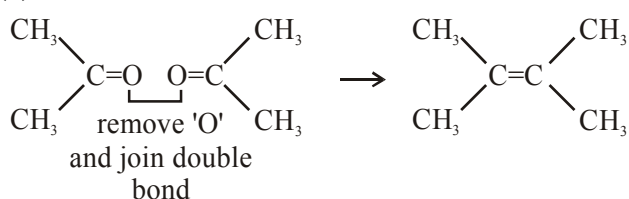


(Reductive Ozonolysis)

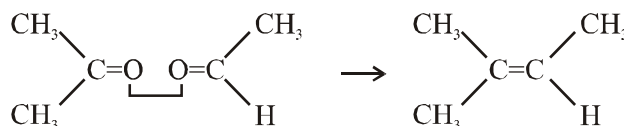


9. Back product determination.

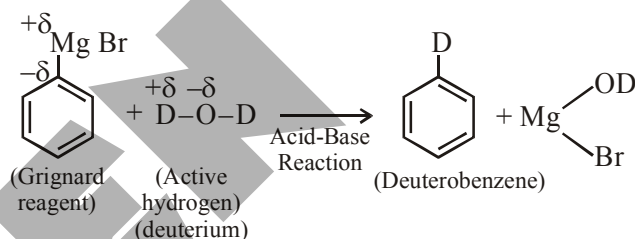
(a)



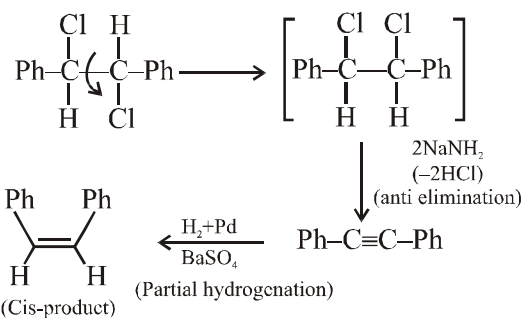
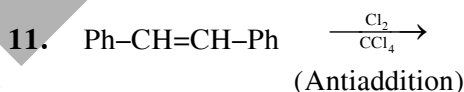
(d)



10.

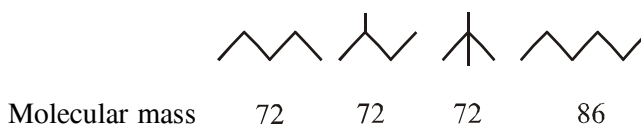


Note:- Zerewitinoff's determination of active or acidic hydrogen.

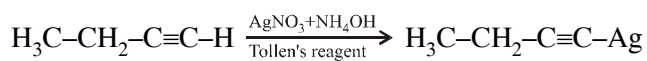


12. Boiling point Van der Waals force of attraction force

(Van der Waals attraction force $\propto$ molecular mass)



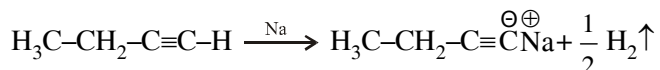
13.



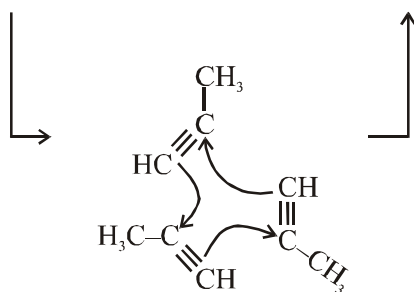
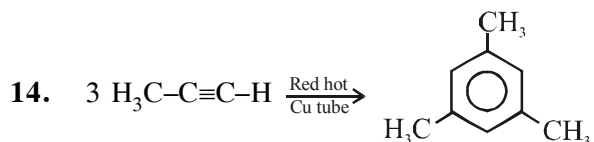
White ppt



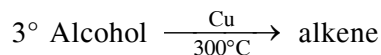
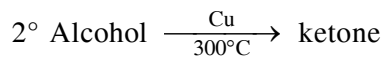
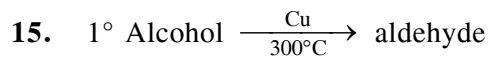
Red ppt



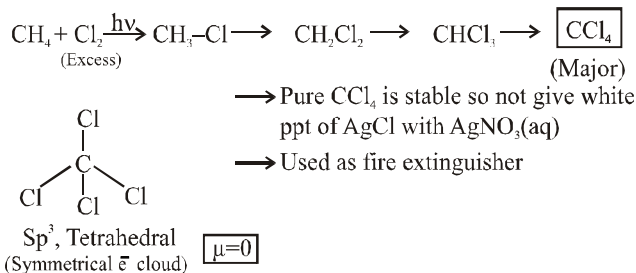
14.



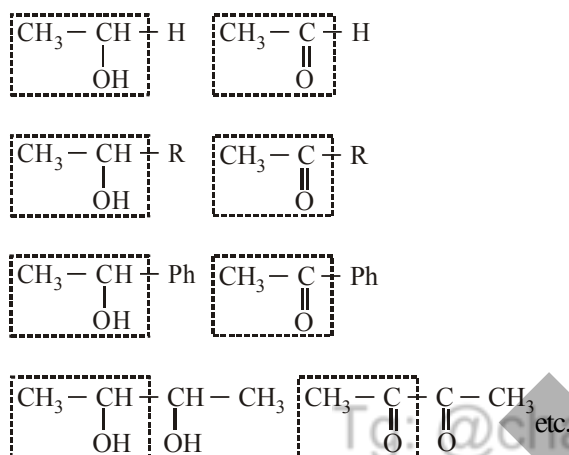
(Cyclic polymerisation)



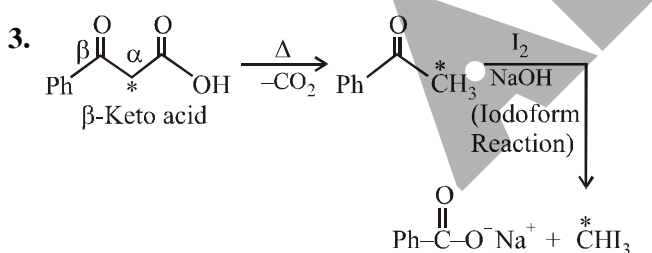
1.



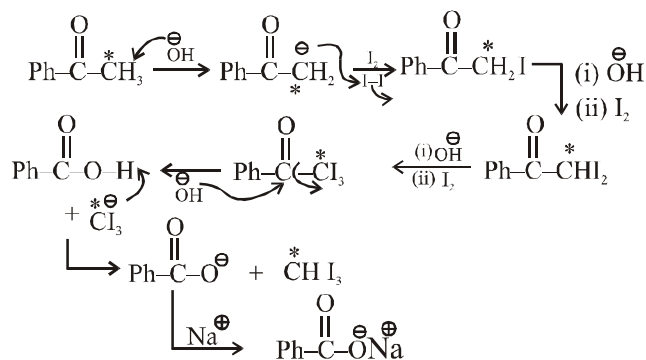
2. The comp. having following structure give positive idoform (haloform) test.



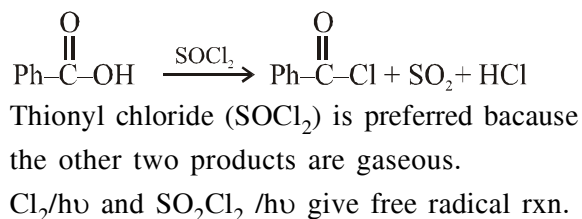
Note : Ethanol, 2-alkanol, in aldehyde only
acetaldehyde and all methyl ketone give
haloform reaction.



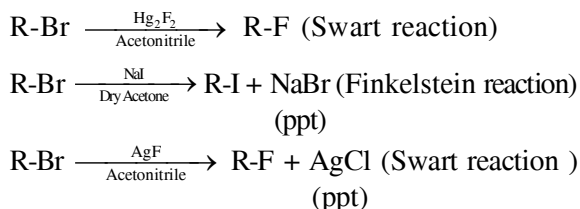
Mechanism :



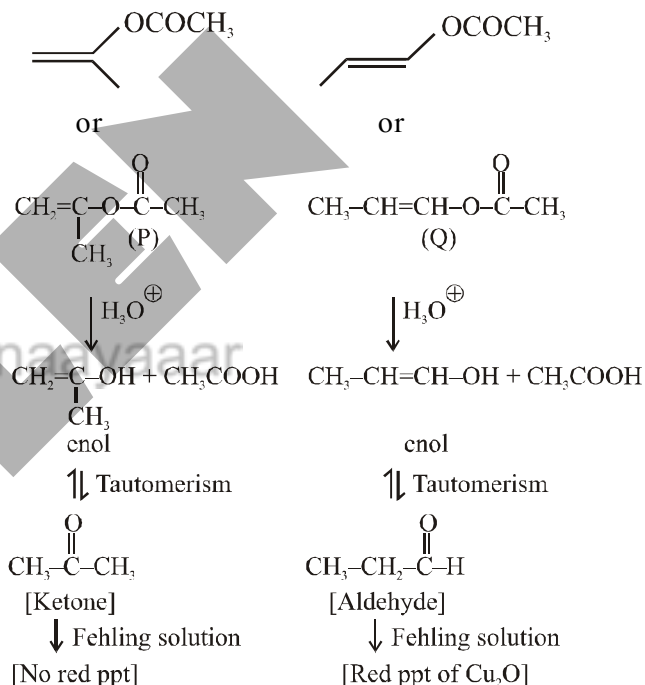
4.



5.

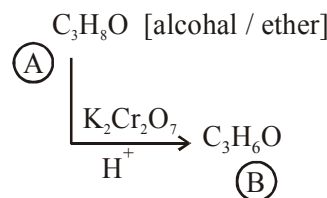


6.

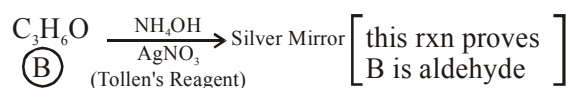


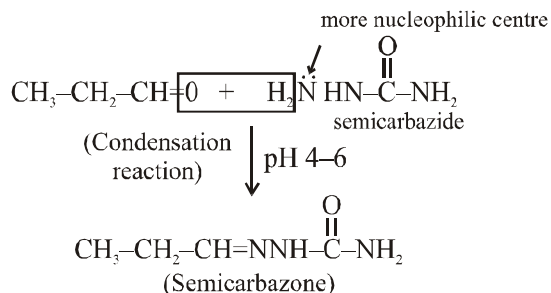
* Aldehyde and α -hydroxy carbonyl give positive test with Fehling solution / Benedict solution / Tollen's reagent.

7.

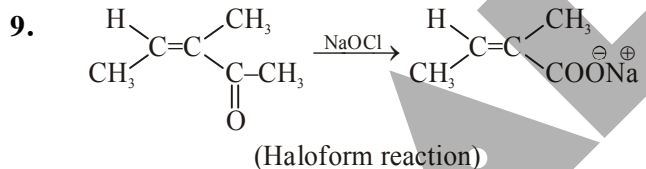
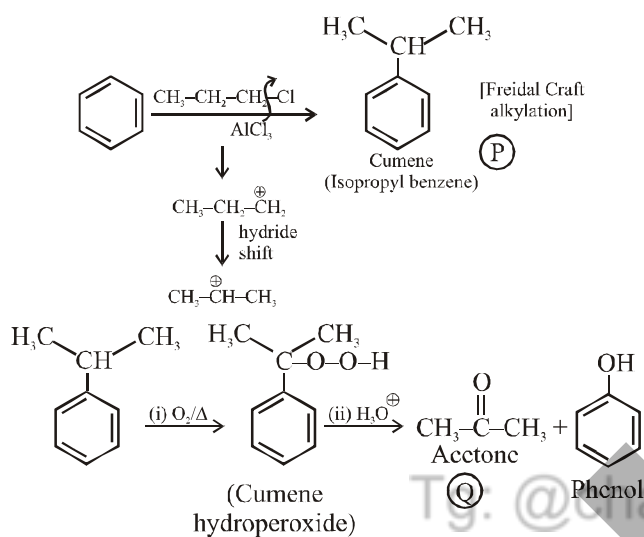


(A) will be alcohol,
(B) obtained from alcohol, may be aldehyde or ketone

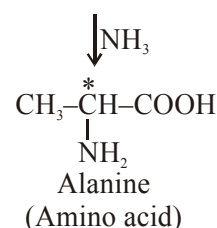
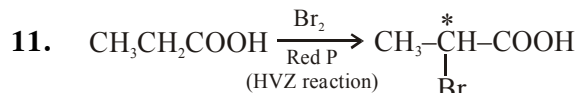
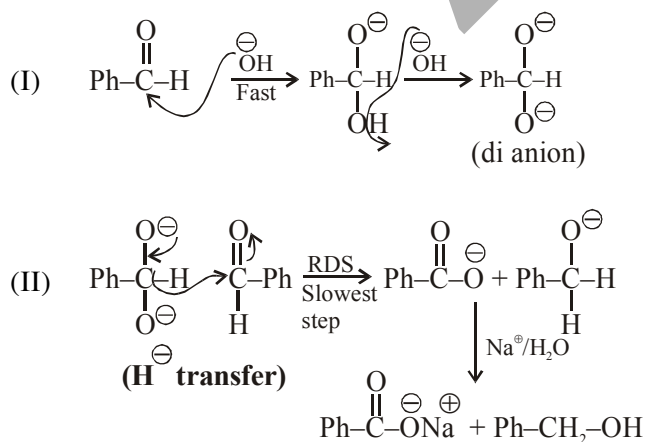




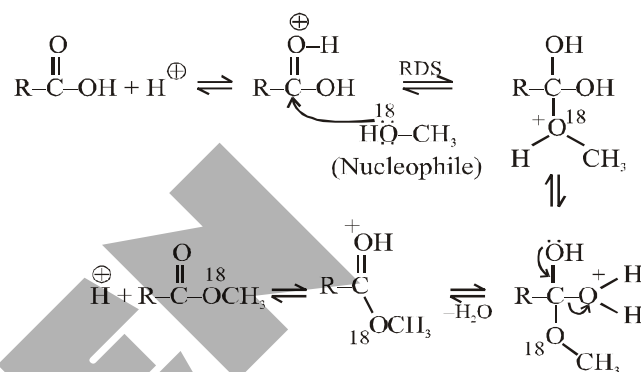
8.



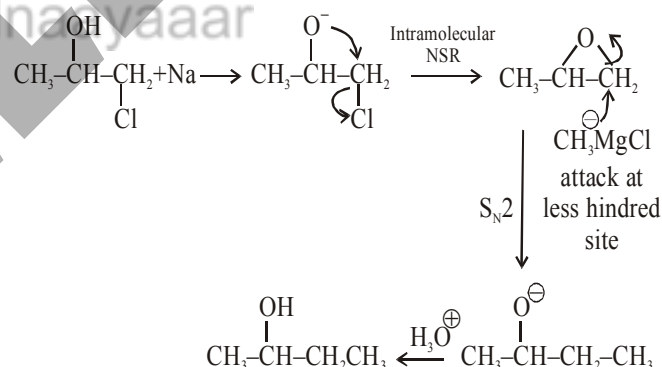
10. Cannizzaro reaction :-



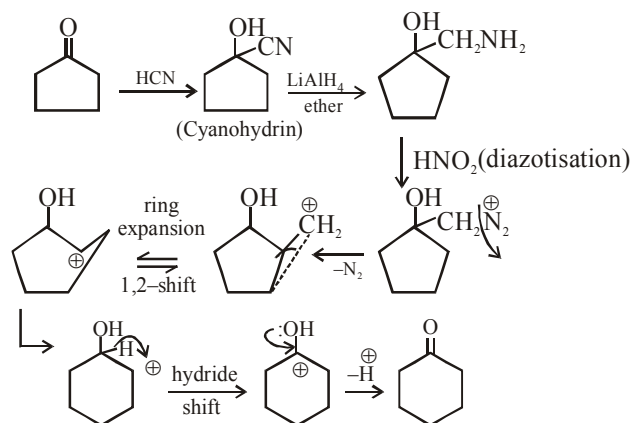
12.



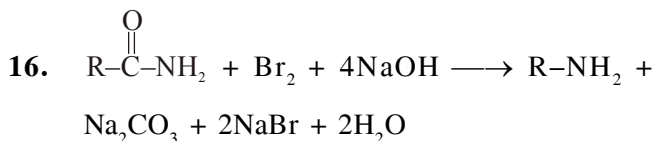
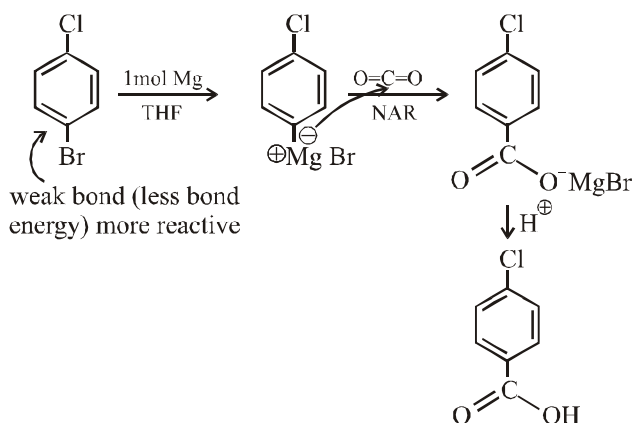
13.



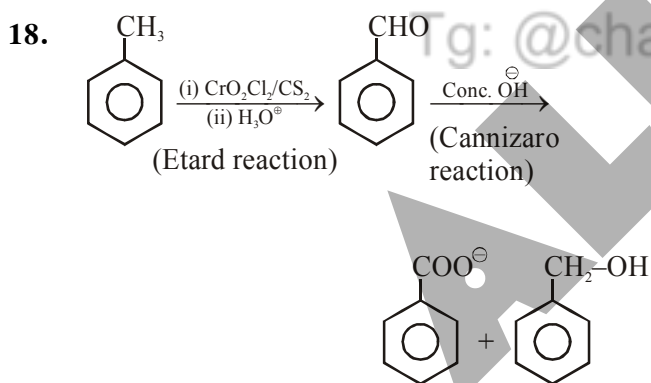
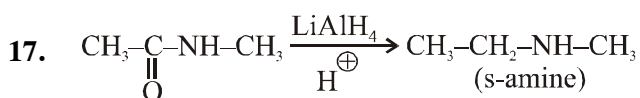
14.



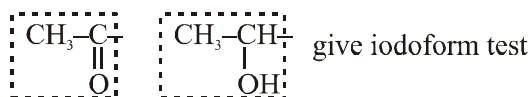
15.



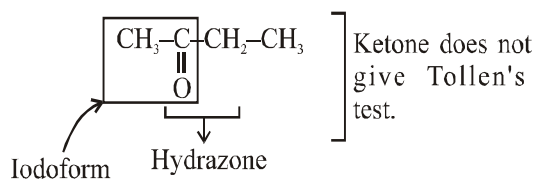
Four mole of NaOH and one mole of Br_2 used for per mole of amine produced.



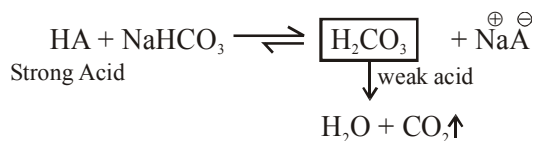
19. * Carbonyl compound form hydrazone with NH_2NH_2
* Ethanol, 2-ethanol, in aldehyde only acetaldehyde and all methyl ketone give haloform reaction.



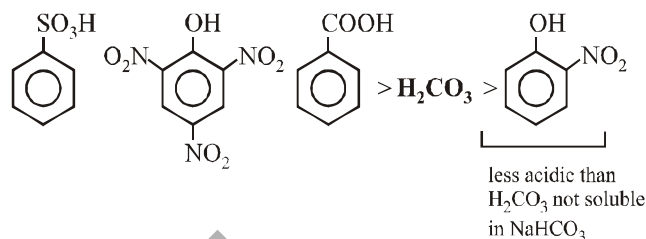
- * All aldehyde and α -hydroxy carbonyl give Tollen's test. So answer is



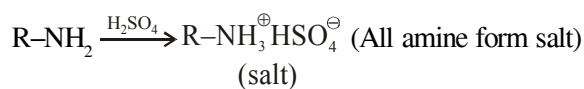
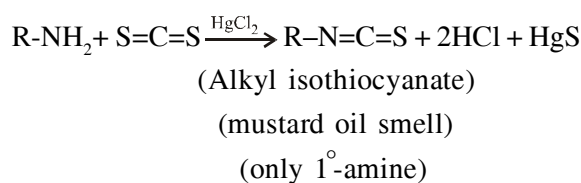
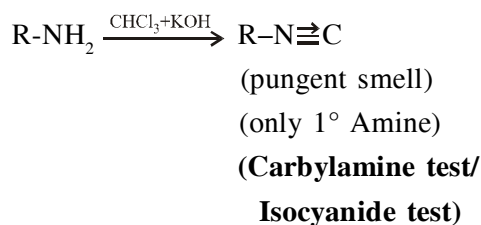
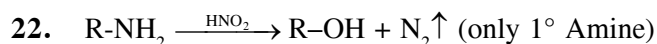
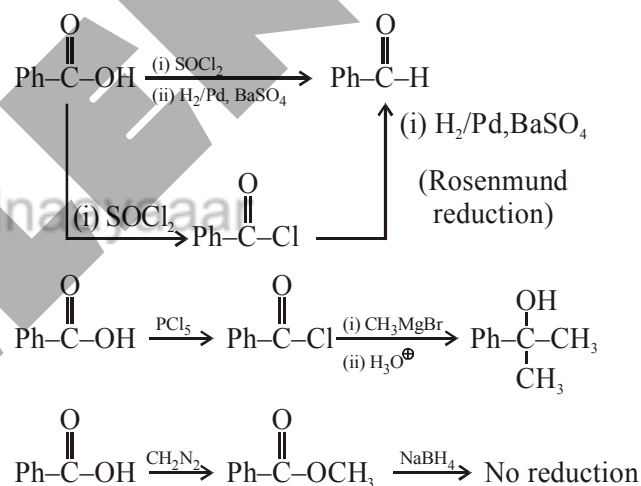
20.



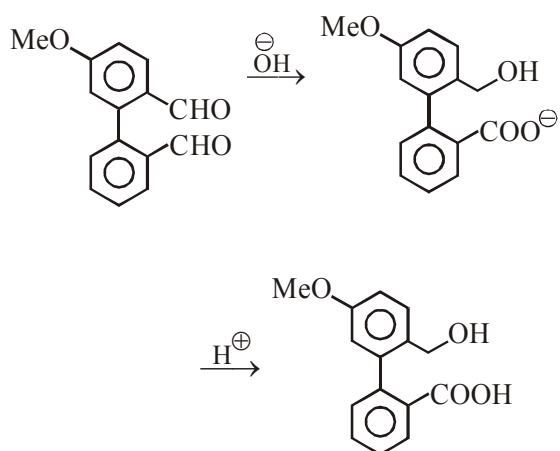
If acid (HA) is more acidic than H_2CO_3 (weak acid) then reaction equilibrium in forward direction, that means acid soluble in NaHCO_3 .



21.

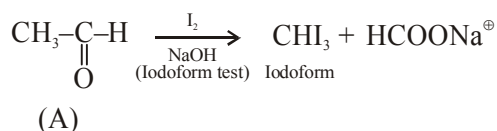
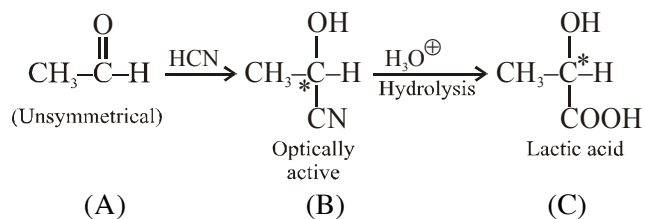


23. More reactive aldehyde oxidises and less reactive aldehyde reduces in Cannizzaro reaction.



24. a-q, b-r, c-p, d-s

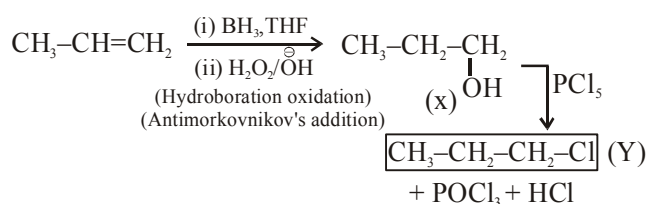
- 25.



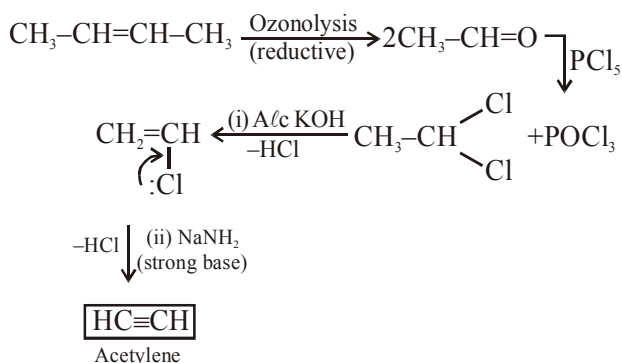
BASED ON CONVERSIONS

RACE # 12

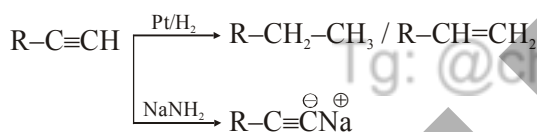
1.



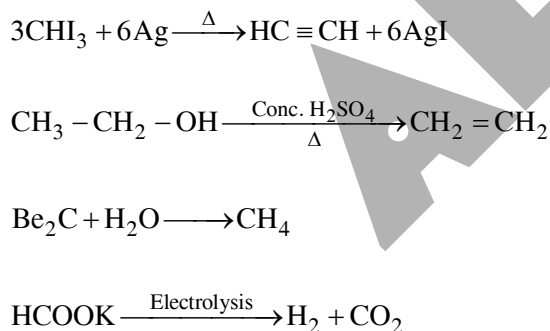
2.



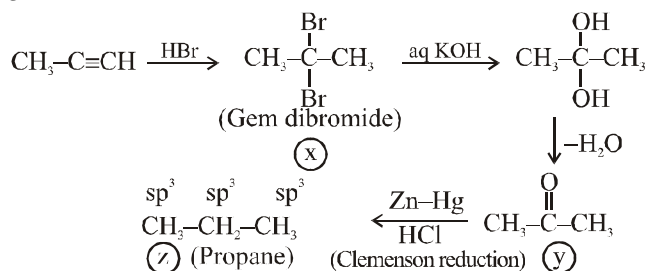
3.



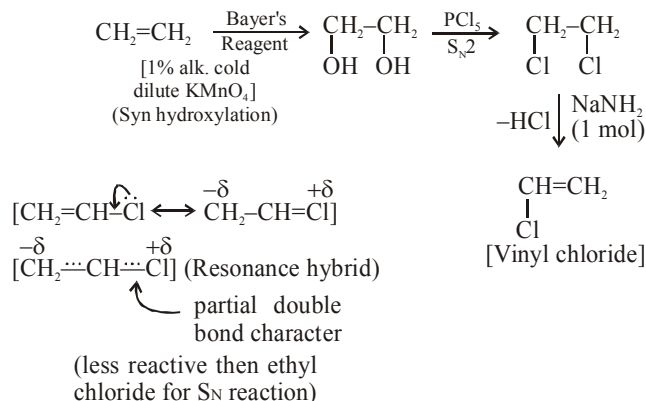
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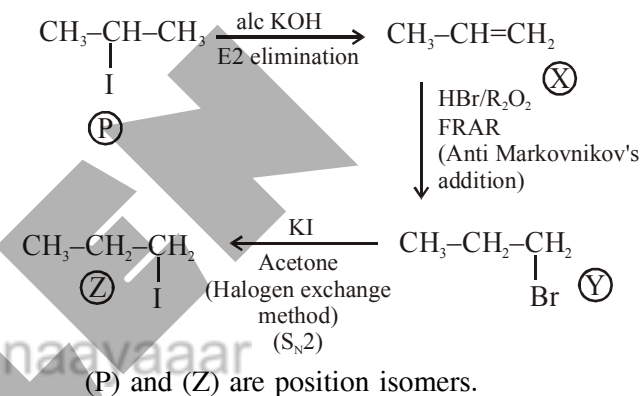
5.



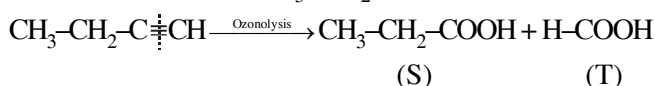
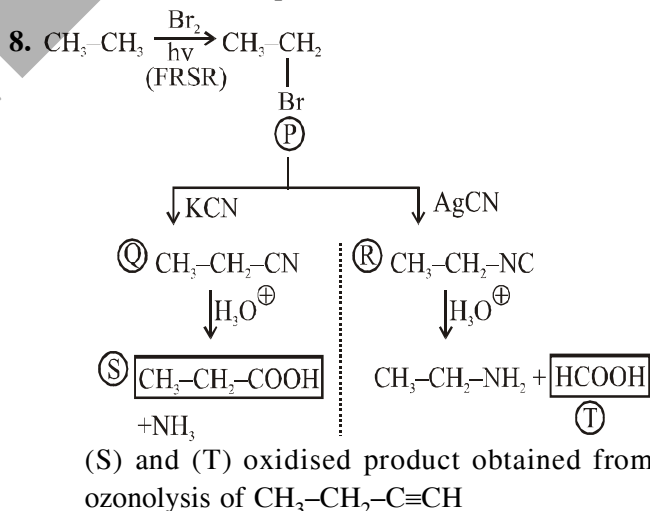
6.



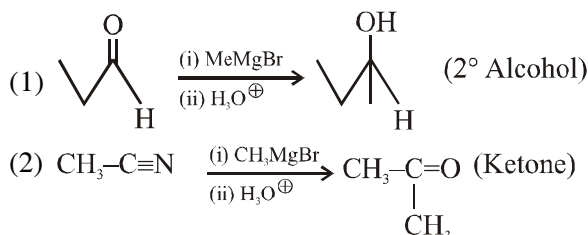
7.

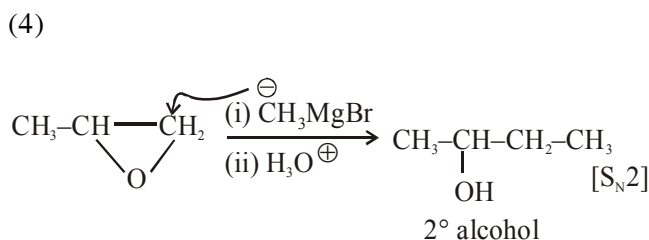
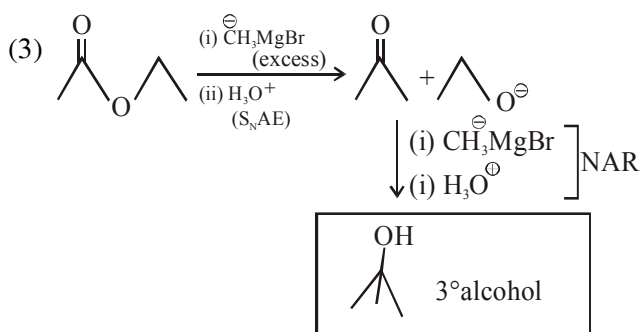


8.



9.

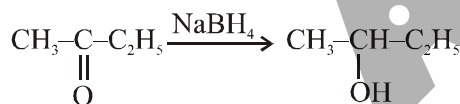
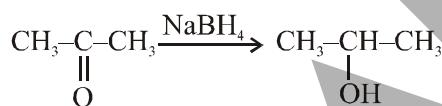
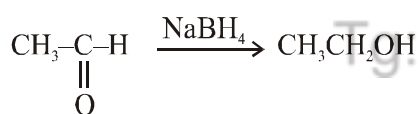




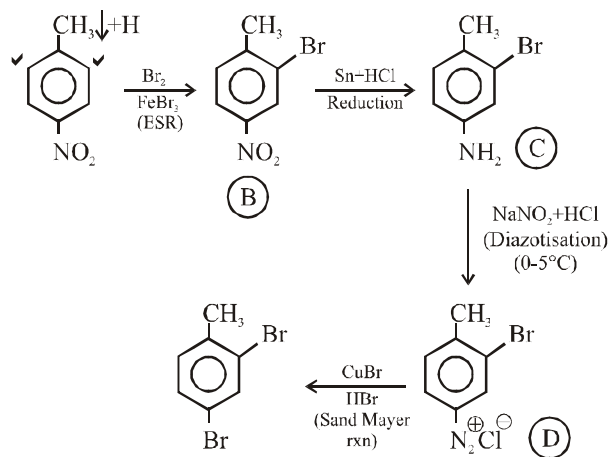
10. NaBH_4 reduces :- (1) Acid chloride (Acid Halide)

(2) Aldehyde

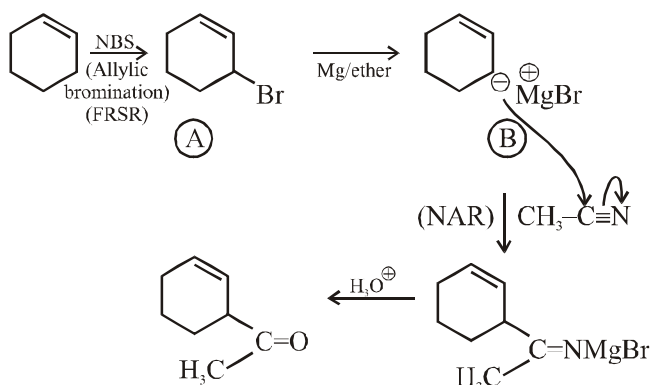
(3) Ketone



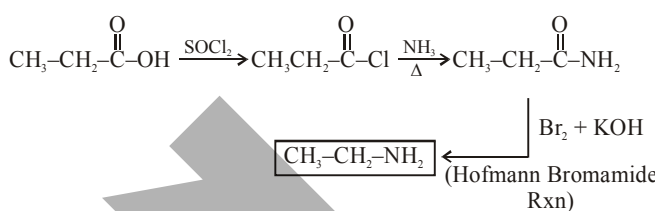
11.



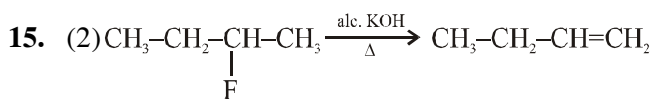
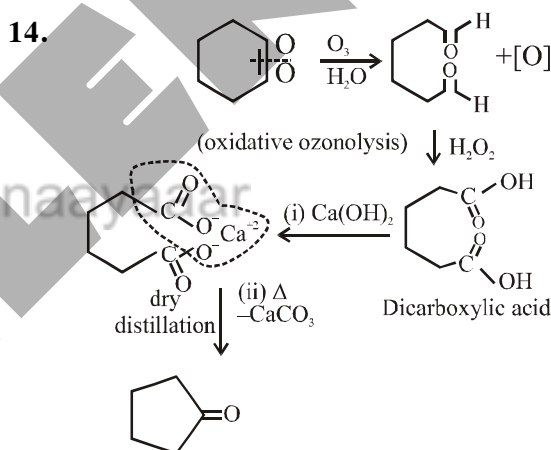
12.



13.

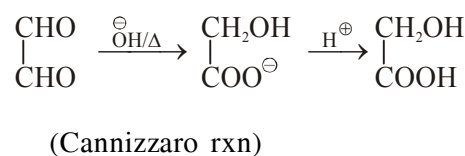
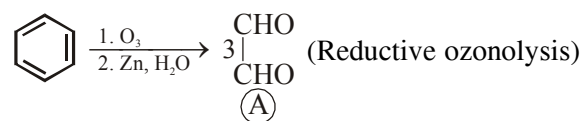


14.

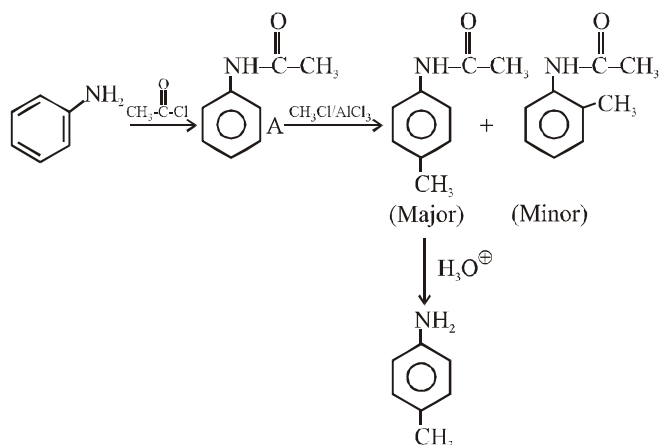


$-\text{F}$, $-\text{NR}_3^+$ are poor leaving group, and generally give Hofmann elimination product.

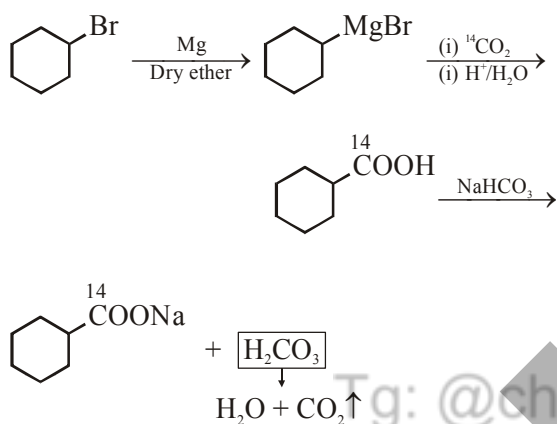
16.



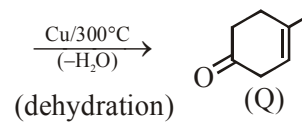
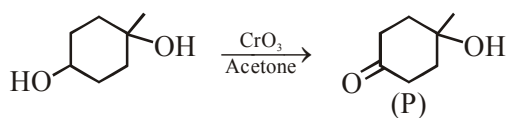
17.



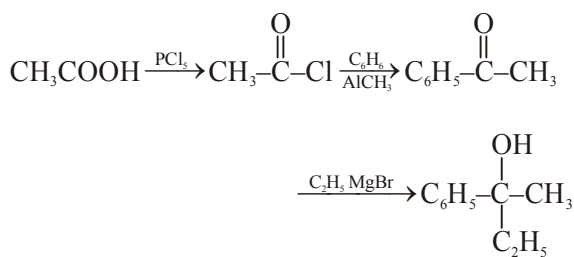
18.



19.

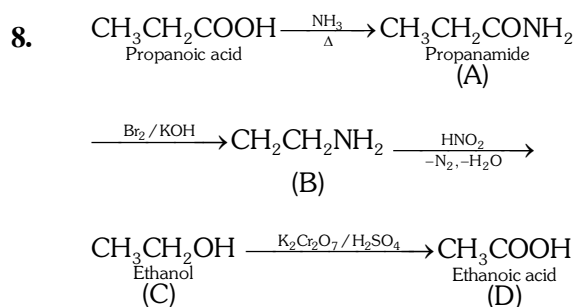
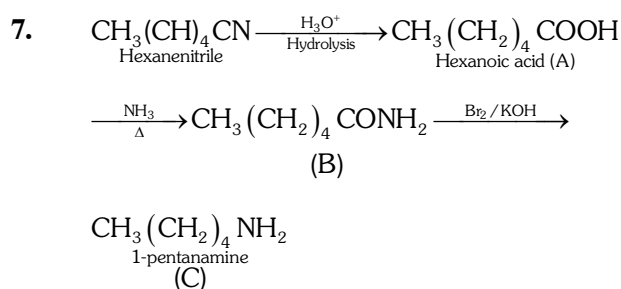
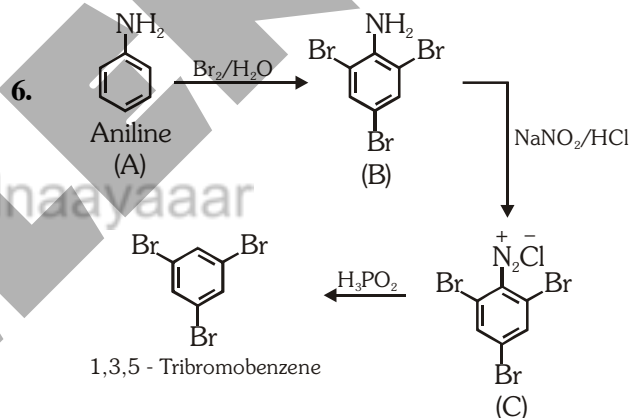
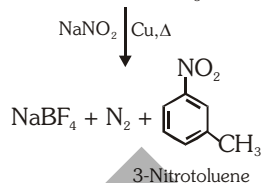
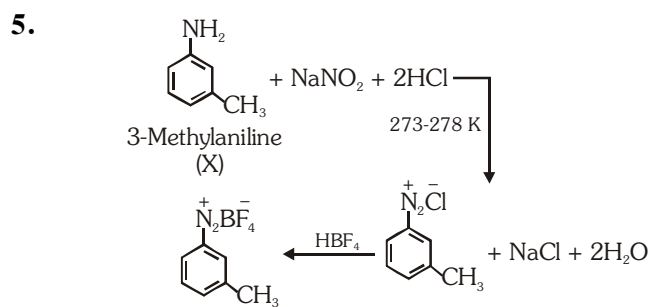
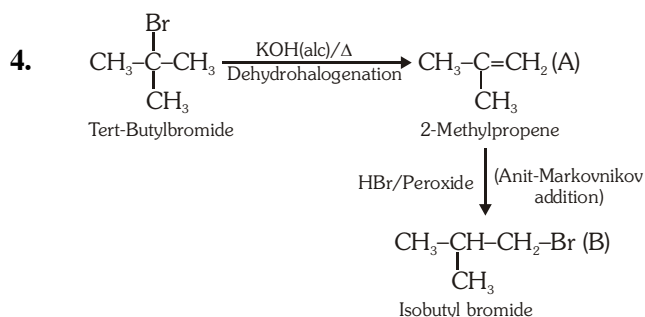
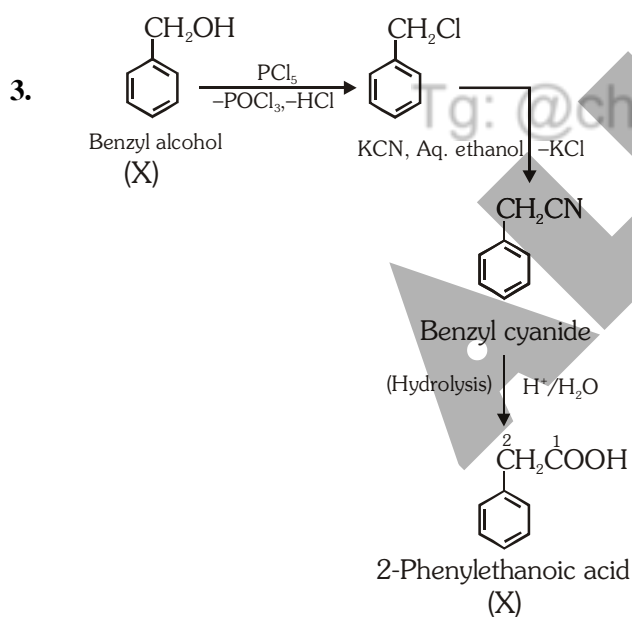
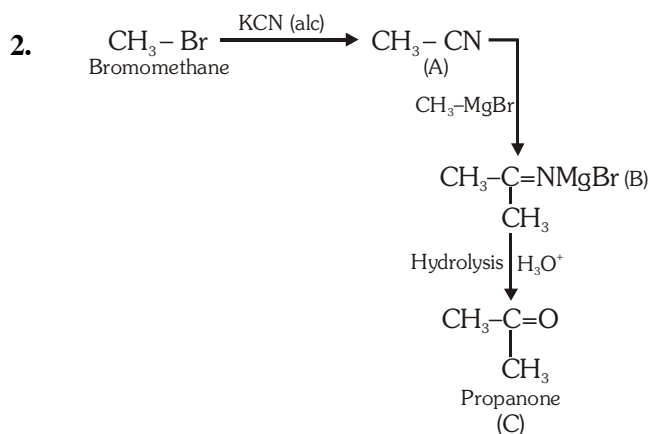
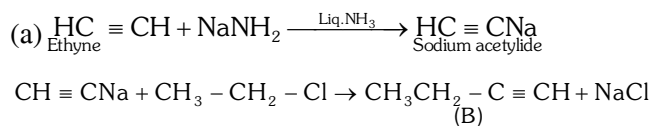
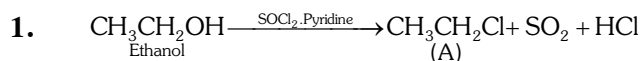


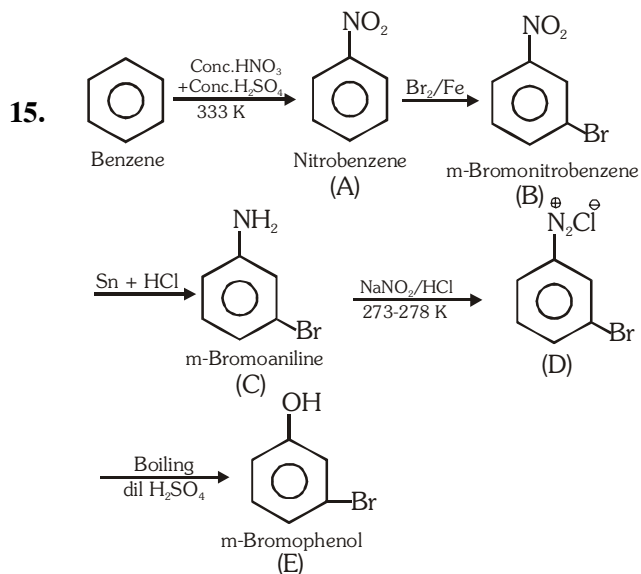
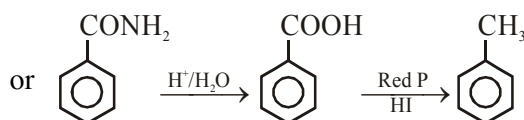
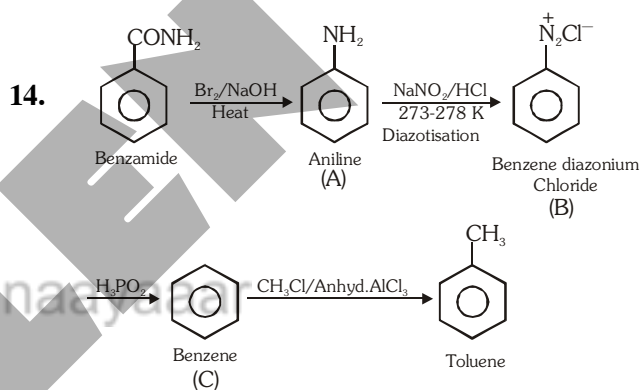
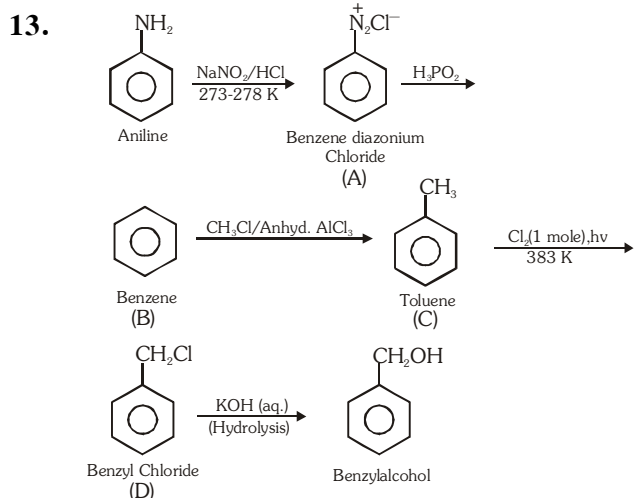
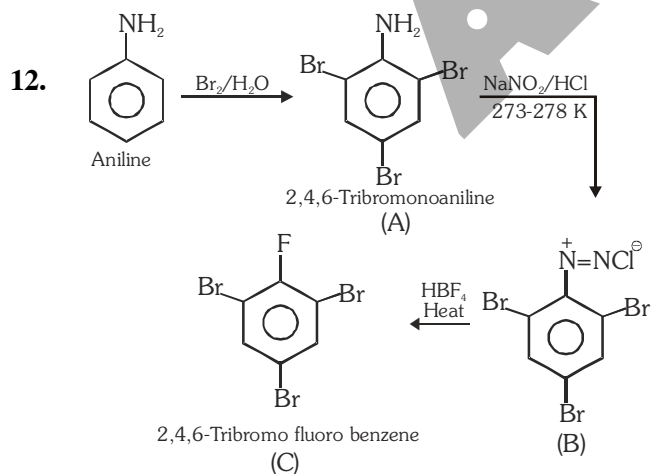
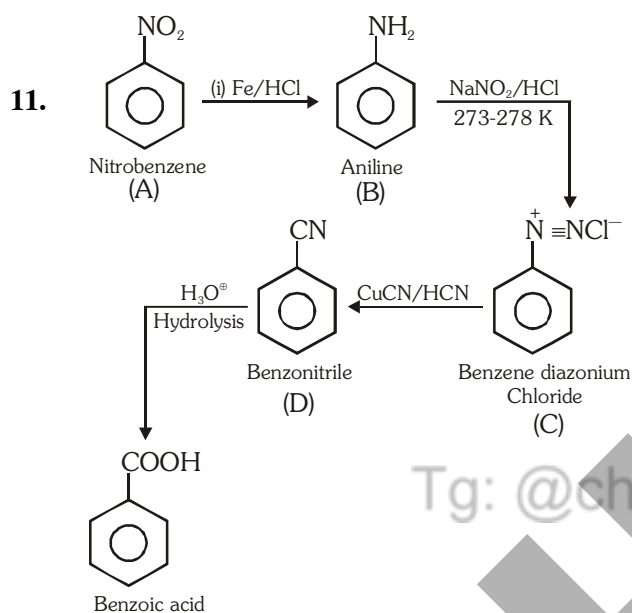
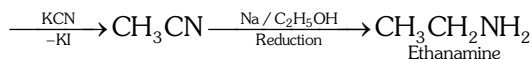
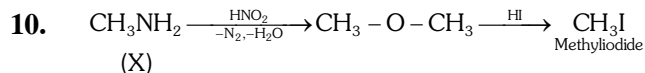
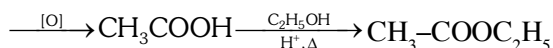
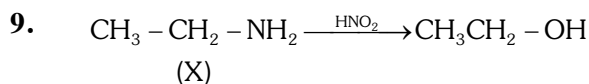
20.



NCERT CONVERSIONS

RACE # 13

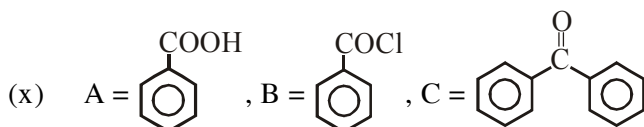
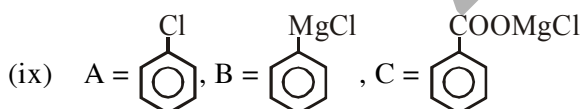
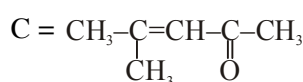
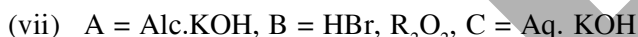
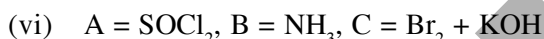
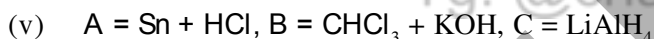
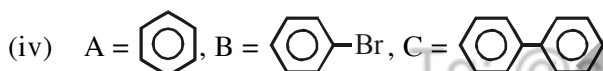
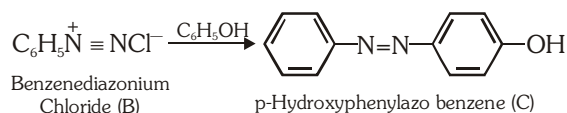
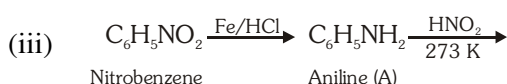
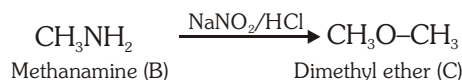
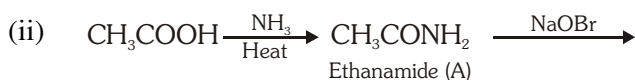
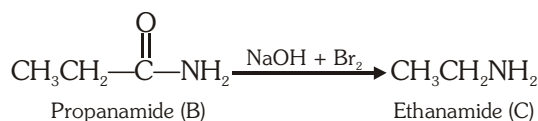




NCERT CONVERSIONS

RACE # 14

1.



2.

